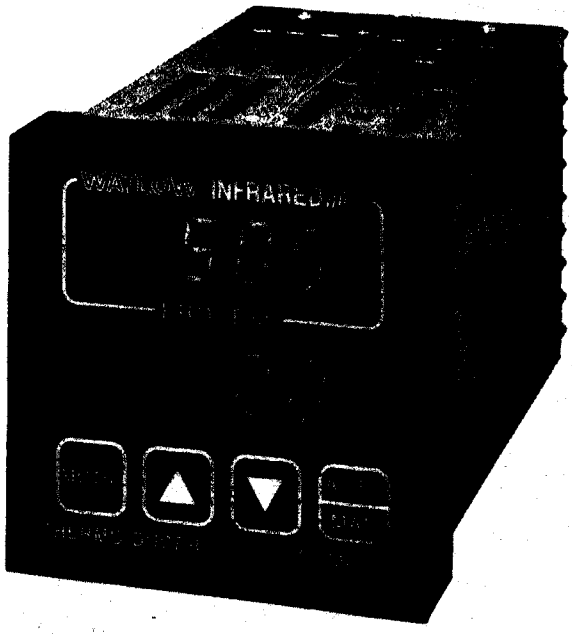
THERMO-DUCER® CSM4



1/4 DIN Microprocessor-Based Auto-tuning Control

User's Manual

WATLOW INFRARED

Watlow Infrared, Box 169, Freeport Industrial Park, Decorah, IA 52101 Phone: 319/382-8446, Fax: 319/382-2418

CSM4-MA10-9105
January, 1991

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Use The Manual

How to Use the Manual

First...

This manual will make your job easier. Reading it and applying the information is a good way to become familiar with the THERMO-DUCER® CSM4. An overview:

Starting Out Chapter 1, Page 4.

Install/Wire Chapter 2, Page 6.

Front Panel Chapter 3, Page 16.

Setup Chapter 4, Page 18.

Tuning Chapter 5, Page 27.

Appendix

Specifications
Noise Guidelines
Calibration
Glossary
Warranty

Notes

The user's manual contains informational notes to alert you to important details. When you see a note icon, look for an explanation in the margin.

♪ or ♫

♪ or ♫

NOTE:
Details of a "Note" appear here, in the narrow box on the outside of each page.

Safety Information

This user's manual also has **boldface** safety information notes to protect both you and your equipment. Please be attentive to them. Here are explanations:

WARNING:
Details of a "Warning" appear here, in the narrow box on the outside of each page.

This symbol in the wide text column alerts you to a **"WARNING,"** a safety hazard which could affect you and the equipment. A full explanation is in the narrow column on the outside of the page.

CAUTION:
Details of a "Caution" appear here, in the narrow box on the outside of each page.

This symbol in the wide text column alerts you to a **"CAUTION,"** a safety or functional hazard which could affect your equipment or its performance. A full explanation is in the narrow column on the outside of the page.

Your Feedback

Your comments or suggestions on this manual are welcome, please send them to: Technical Writer, Watlow Controls, 1241 Bundy Blvd., Winona, MN 55987, or phone 507/ 454-5300. The Watlow THERMO-DUCER® CSM4 User's Manual and integral software are copyrighted by Watlow Winona, Inc., © 1990, with all rights reserved. blr0191

Technical Assistance

If you encounter a problem with your Watlow Infrared Control System, review all of your configuration information to verify that your selections are consistent with your application... Inputs, Outputs, Alarms, Limits, etc. If the problem persists after checking the above, you can get technical assistance by dialing: 1-319-382-8446

An Application Engineer will discuss your problem with you. Please have the following information available when calling:

- Complete model number
- Serial Number
- All configuration information
- User's Manual

The model and serial numbers can be found on the outside of the case.

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Chapter 1

Starting Out With The Watlow THERMO-DUCER® CSM4, A Microprocessor-Based, Non-Contact Temprature Control

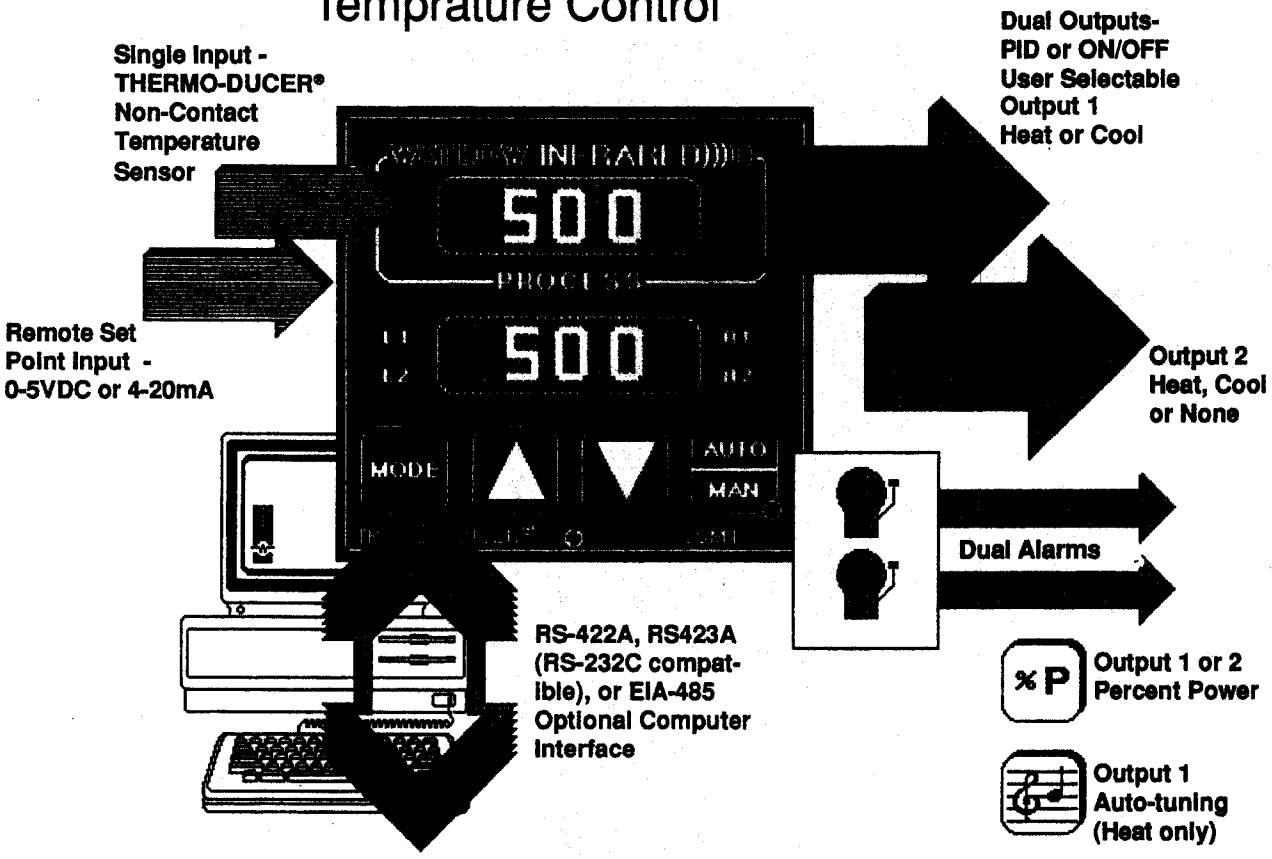

Single Input - THERMO-DUCER® Non-Contact Temperature Sensor
Remote Set Point Input - 0-5VDC or 4-20mA
Dual Outputs- PID or ON/OFF User Selectable Output 1 Heat or Cool
Output 2 Heat, Cool or None
Dual Alarms
RS-422A, RS423A (RS-232C compat-ible), or EIA-485 Optional Computer Interface
Output 1 or 2 Percent Power
Output 1 Auto-tuning (Heat only)
500
500
MODE
AUTO
MAN

Figure 1 - THERMO-DUCER® CSM4 Input and Output Overview.

General Description

Welcome to the Watlow Infrared THERMO-DUCER® CSM4, a 1/4 DIN micro-processor-based auto-tuning control featuring Automatic/Manual capability with bumpless transfer. The CSM4 accepts a single input, and has dual outputs and alarms. In the Auto mode, the THERMO-DUCER® CSM4 has closed loop control with sensory feedback, while the Manual mode has open loop control with user defined output power level. The CSM4 accepts a single input from a non-contact THERMO-DUCER® sensor. The primary output is Heating or Cooling, while the secondary output can be Heat, Cool or None.

With the THERMO-DUCER® CSM4 you can select either PID or ON/OFF for Output 1 or 2. You may input a complete set of PID parameters for both outputs, and also select automatic tuning in the heating mode from the front panel for Output 1. This includes proportional band, reset and rate. By setting either output's proportional band to zero, the THERMO-DUCER® CSM4 becomes a simple ON/OFF control with the switching differential selectable under the HYS Setup parameter.

Operator-friendly features include automatic LED indicators to aid in monitoring and setup, as well as calibration offset at the front panel. The THERMO-DUCER® CSM4 automatically stores all information in a non-volatile memory.

Putting Your Control System To Work

To put your THERMO-DUCER® CSM4 to work, we suggest the following steps:

- Read the User's Manual.
- Plan your installation and wiring.
- Cut the panel mounting hole and install the control.
- Connect the non-contact temperature sensor to the THERMO-DUCER® CSM4.
- Wire your THERMO-DUCER® CSM4 to the system.
- Start the system, and configure the THERMO-DUCER® 500 to the CSM4.
- Tune the THERMO-DUCER® CSM4.
- Make final adjustments to the control parameters and record the data.

Overview of the THERMO-DUCER® CSM4 Menus

Before getting into the details of installing and wiring the THERMO-DUCER® CSM4, take a look at Figure 2, and at the three different menus. "Setup," "Operation," and "Calibration." After you feel comfortable with the names and their functions, move on to installation and wiring.

Setup	Configure the CSM4's features to your application. Establish levels of operator access, units of measure, low and high range limits, Hysteresis, Output 1 and 2, alarms and communications configuration. Also configures the THERMO-DUCER® sensor to the control.
Operation	Enter the set point and the PID tuning values and alarm set points here. Parameters for proportional band, reset, rate and cycle time for Outputs 1 and 2, alarm low and high limits; deadband, calibration offset, emissivity and auto-tune are here also.
Calibration	Supplies one of various signals to the THERMO-DUCER® CSM4, and performs auto-calibration. Calibration procedures should **only** be attempted with proper equipment and by qualified personnel.

Figure 2 - Overview of the THERMO-DUCER® CSM4.

Where To Go From Here

If your THERMO-DUCER® CSM4 is already installed and wired, go directly to "How to Use the Keys and Displays," Chapter 3. If not, turn the page to Chapter 2, "How to Install and Wire the THERMO-DUCER® CSM4," and proceed from there.

Chapter 2

How to Install and Wire the THERMO-DUCER® CSM4

System Planning

This chapter tells you how to install the THERMO-DUCER® CSM4. All mounting and wiring information is right here. Because Watlow controls are thoroughly tested and "burned in" before leaving the factory, the THERMO-DUCER® CSM4 is ready to install when you receive it.

But before you begin working, **read through this chapter** to gain an understanding of the entire installation. Consider sensor installation carefully. For detailed information you'll need to look at the noise reduction guidelines in Appendix 2 of this manual before making your panel cutout.

Installation Information

The THERMO-DUCER® CSM4 mounts in a panel cutout with two brackets. These brackets hold the case against the front panel. The THERMO-DUCER® CSM4 behind-panel dimensions are 3.6" (90 mm) high by 3.6" (90 mm) wide by 6" (152 mm) deep. Figure 3 shows the dimensions of the front panel bezel. The CSM4 weighs 2.75 lbs. (1.25 kg) maximum.

For unit dimensional and mounting information, including the location of mounting brackets and size of the front panel cutout, see Figures 3 through 5. Your panel's thickness can be from 0.06" (1.5 mm) to 0.25" (6.3 mm).

Installation Procedure

NOTE:
Removing the THERMO-DUCER® CSM4 chassis from its case may make mounting easier.

Follow this procedure to mount the THERMO-DUCER® CSM4 non-contact temperature control system:

1. Make a panel cutout per the dimensions in Figure 4.
2. Remove the CSM4 from its case by turning the front panel screw 90° counterclockwise. Grip the bezel firmly and pull the chassis out of the case.

CAUTION:
The front panel screw turns 90° only. Do not apply excessive force or turn the screw more than 90°.

3. Place the case in the cutout you just made.
4. Attach the mounting brackets either to the top and bottom, or to both sides of the unit.
5. Tighten the mounting brackets securely against your panel.
6. Insert the control chassis into its case and press the bezel to seat it. Turn the front panel screw 90° clockwise to lock the control in place. The hardware installation is complete. Proceed to the wiring section from here.

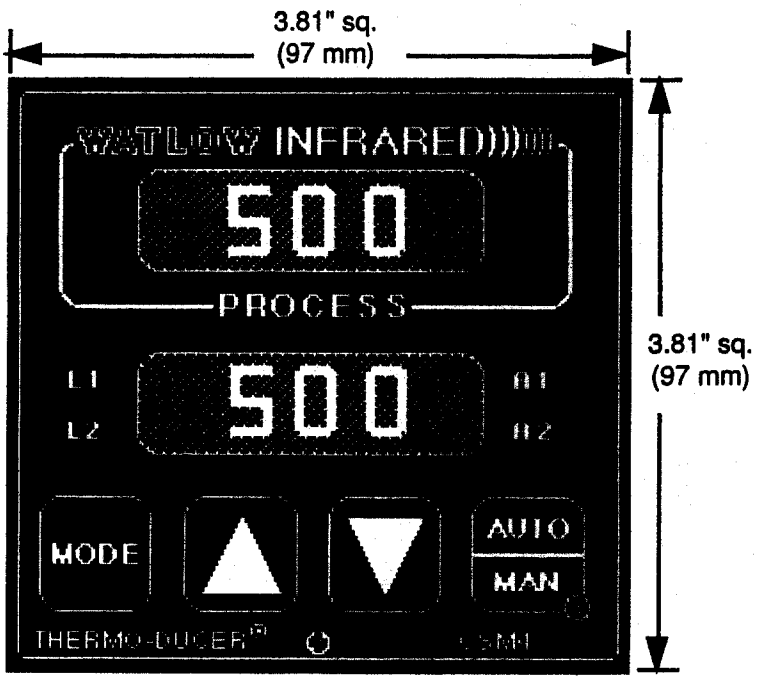


Figure 3 - THERMO-DUCER® CSM4 Faceplate Dimensions

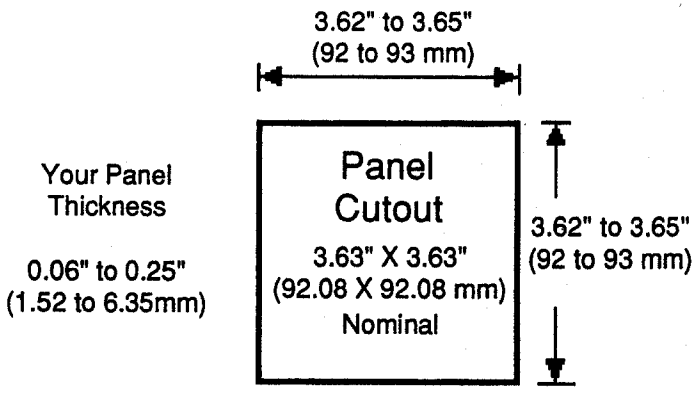
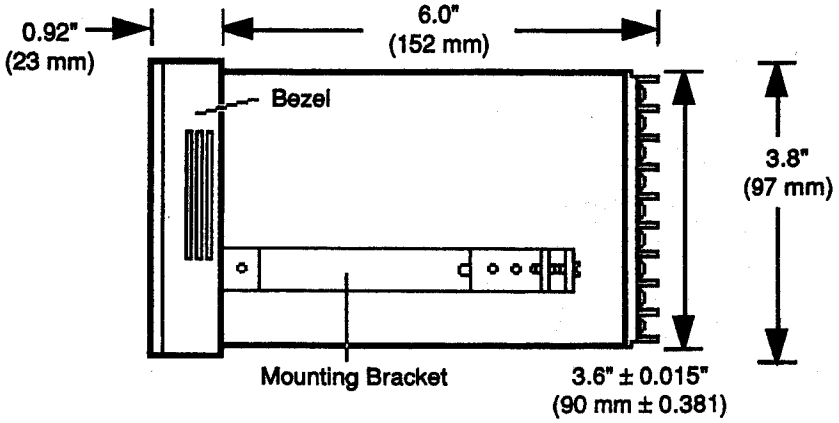


Figure 4 - THERMO-DUCER® CSM4 Panel Cutout Dimensions



NOTE:

Add 1.06 in. (27 mm) to the total length of the control when the noise filter module is installed on the terminal strip.

Figure 5 - THERMO-DUCER® CSM4 Sideview Dimensions

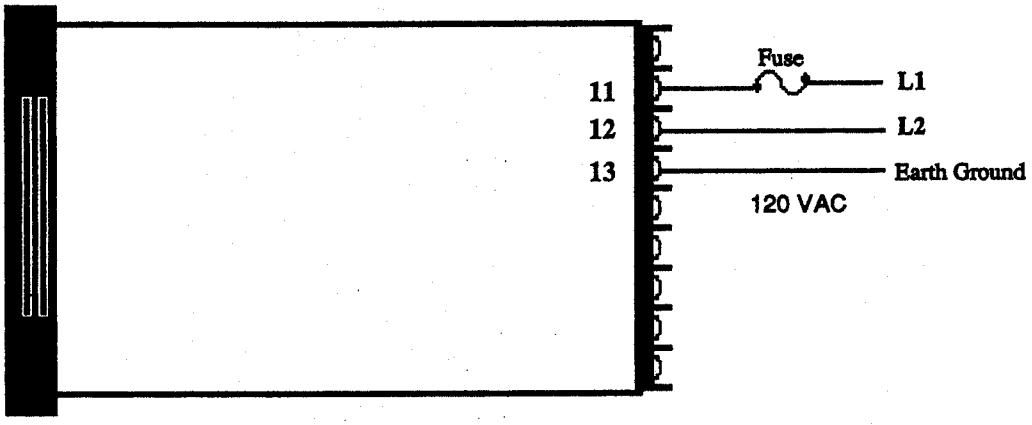
How to Wire the THERMO-DUCER® CSM4

The THERMO-DUCER® CSM4 wiring is illustrated by model number option. Check the unit terminal designation sticker on the control and compare your model number to those shown here and also the model number breakdown in the Appendix of this manual.

THERMO-DUCER® CSM4 internal circuits appear "inside" the line drawing of the CSM4, while connections and terminal designations appear "outside" the line drawing. All outputs are referenced to a de-energized state. The final wiring figure is a typical system example.

When you apply power without a THERMO-DUCER® on the terminal strip, the CSM4 displays "- - - -" in the Upper display, and a "0" in the Lower display. Press the AUTO/MANUAL key twice, and an ER 7 is displayed for one second. This error indicates an open sensor or A/D error. Remove power to the control and connect the sensor properly, see Page 9. All wiring and fusing must conform to the National Electric Code and to any locally applicable codes as well.

Figure 6 - 120 VAC Power Wiring



WARNING:

To avoid potential electric shock, use National Electric Code (NEC) safety practices when wiring and connecting this unit to a power source and to electrical sensors or peripheral devices.

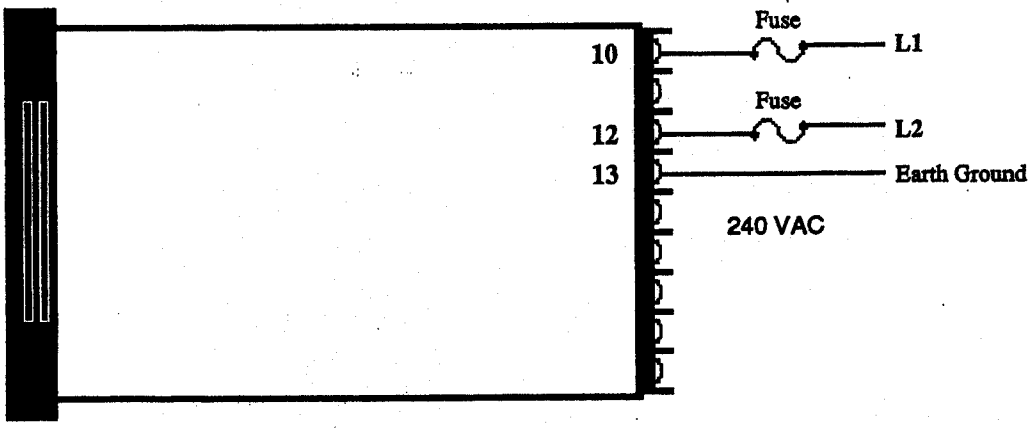


Figure 7 - 240 VAC Power Wiring

Input Option "A" **THERMO-DUCER® Input**
Terminals 4, 5, 7 & 9

Model # CSM4 - **A**_ _ _ - _ 000

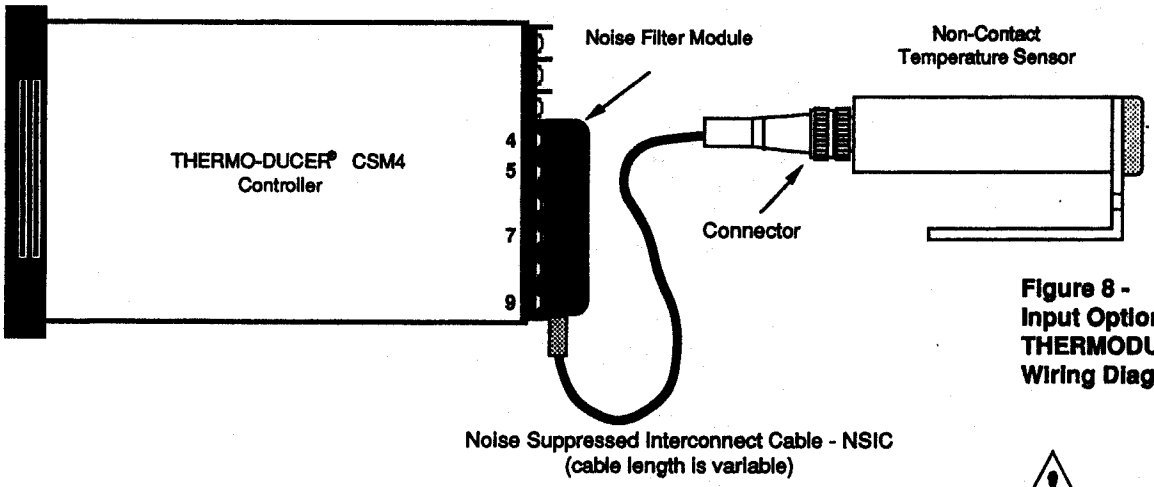


Figure 8 - Input Option "A" THERMODUCER® Wiring Diagram.

Slide the noise filter module into Terminal numbers 4, 5, 7, and 9 as indicated on the side of the noise module. You **must** connect the green wire on the noise filter module to ground, Terminal #13, located on the back of the control. If not connected, your system will pick up noise from outside sources.

The noise suppressed interconnect cable (NSIC), non-contact temperature sensor, and accessories are ordered separately. Refer to the THERMO-DUCER® non-contact sensor manual and the NSIC data sheet for more information.

WARNING:
To avoid electric shock, make all connections on the back of this control before connecting power to the control.

Local/Remote Set Point Wiring
0-5 VDC Remote Input Signal
Terminals 1 - 3

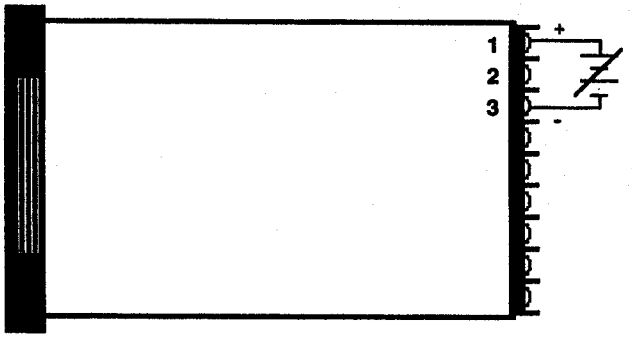


Figure 9 - 0-5VDC Remote Set Point Wiring

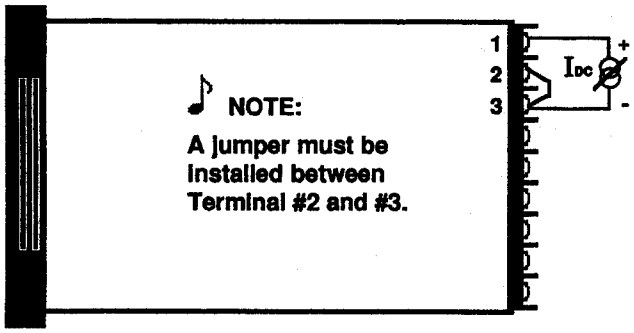


Figure 10 - 4-20mA Remote Set Point Wiring

Output 1 Wiring

Output 1 Option "B", **Solid State Relay**
Terminals 17 & 18

CSM4-X**B**XX-X000

Terminal	Function	
16	Not Used	
17	N.O.	Output #1
18	COM.	

Model # CSM4 - _ **B** _ _ - _ 000

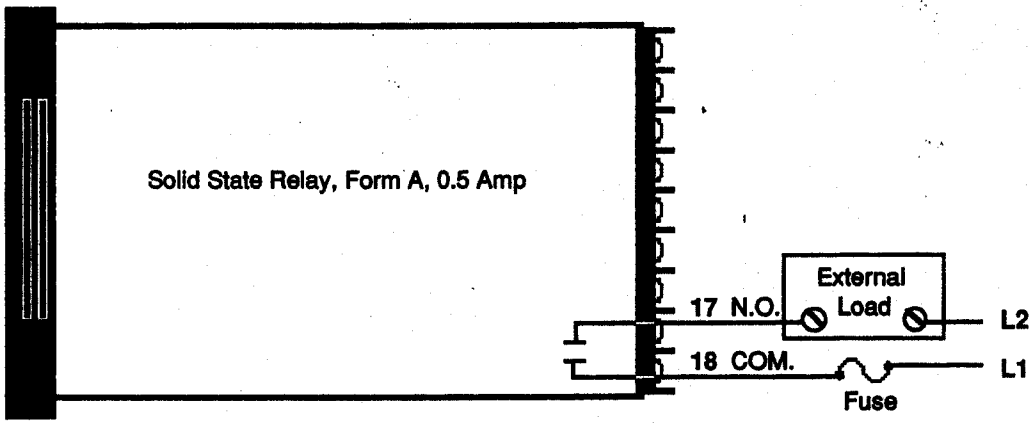


Figure 9 - Solid State Relay, Output 1, Option "B" Wiring Diagram.

Solid State Relay
Watlow's solid state relays change state at zero volts, which is "zero-cross switching." They are also optically isolated, which means the output circuitry is energized by infrared light striking a photo-sensitive device. This virtually eliminates electrically generated noise, plus output to input electrical isolation. **Off state impedance is 20KΩ minimum.**

Output 1 Option "C", **DC Output (Open Collector)**
Terminals 16 & 17

CSM4-X**C**XX-X000

Terminal	Function	
16	DC -	Output #1
17	DC +	
18	Not Used	

Model # CSM4 - _ **C** _ _ - _ 000

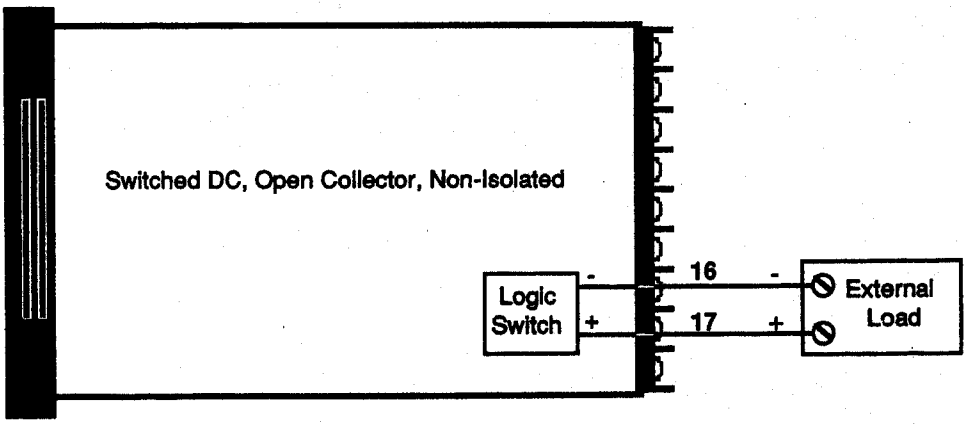


Figure 10 - DC Output 1 (Open Collector), Option "C" Wiring Diagram.

Switched DC
Watlow's solid state switch is a low current DC output (open collector) used to switch an external power switching device such as an SSR or an electro-mechanical relay. The input specifications of the power switching device must match those listed for the SS switch output. The power switching device must provide isolation between the SS switch output and load power since the SS switch output is a non-isolated output. Minimum load resistance is 500Ω. Available current is minimum 9mA, 22mA maximum.

Output 1 Option "D", **Mechanical Relay, Form C, 6 Amp**
Terminals 16 - 18
Model # CSM4 - _ **D** _ _ - _ 000

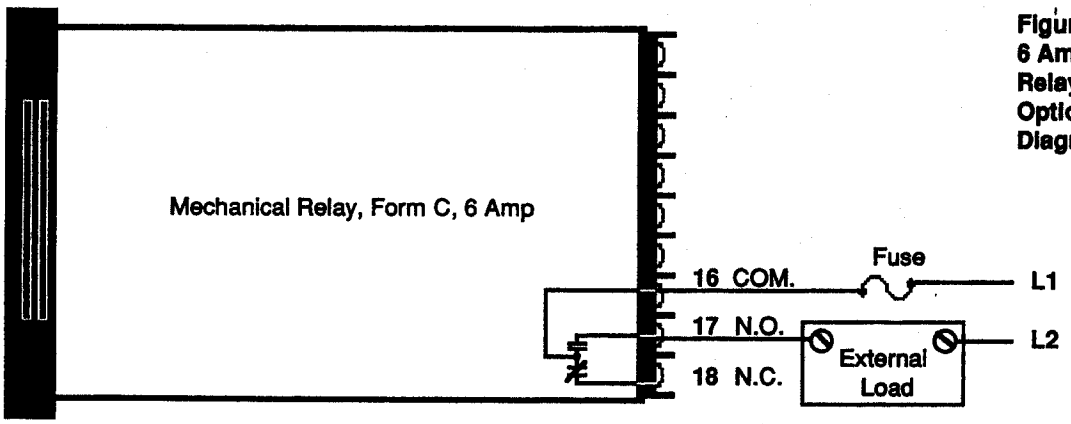


Figure 11 - 6 Amp Mechanical Relay, Output 1, Option "D" Wiring Diagram.

Mechanical Relay
The electro-mechanical relay is an electrical and mechanical device with moving parts. When power is applied to the relay solenoid, contact closure is created through movement of the "common" contact of the relay.
Off state impedance is 20KΩ minimum.

CSM4-X[D]XX-X000

Terminal	Function	
16	COM.	Output #1
17	N.O.	
18	N.C.	

Output 1 Option "F", **Process, 4-20mA**
Terminals 17 - 18
Model # CSM4 - _ **F** _ _ - _ 000

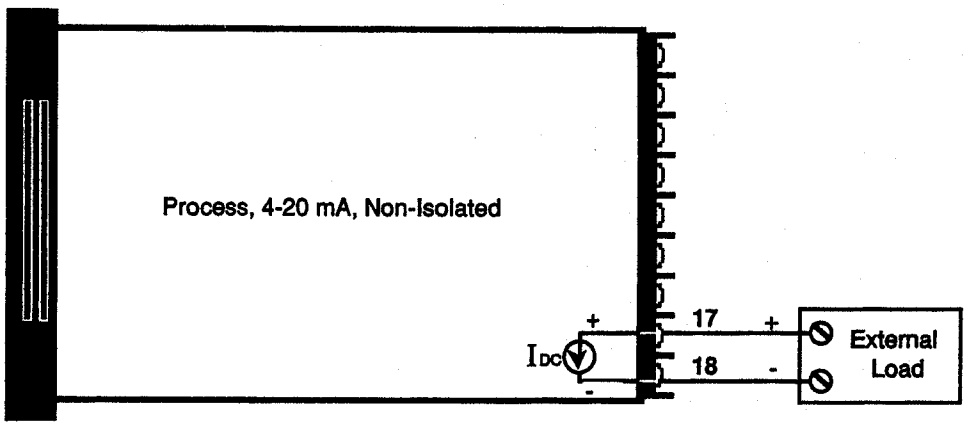


Figure 12 - 4-20mA, Output 1, Option "F" Wiring Diagram.

Process Output
Proportional value determined by the control to balance the sensor input and set point. This value will fall between 4 - 20 mA depending on your process output type.

CSM4-X[F]XX-X000

Terminal	Function	
16	Not Used	
17	4-20mA +	Output #1
18	4-20mA -	

Output 2 Wiring

Output 2 Option "A", **No Output 2**

Model # CSM4 - _ _ **A** _ - _ 000

CSM4-XX[A]X-X000	
Terminal	Function
14	Not Used
15	Not Used

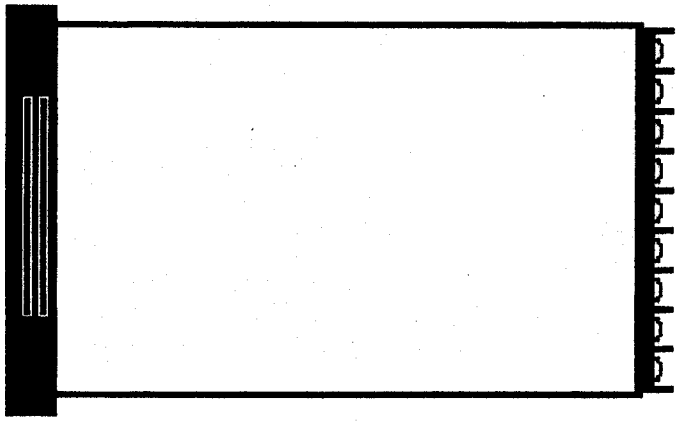


Figure 13 - None Used, Output 2, Option "A" Wiring Diagram.

Output 2 Option "B", **Solid State Relay**
Terminals 14 & 15

Model # CSM4 - _ _ **B** _ - _ 000

CSM4-XX[B]X-X000		
Terminal	Function	
14	N.O.	Output #2
15	COM.	

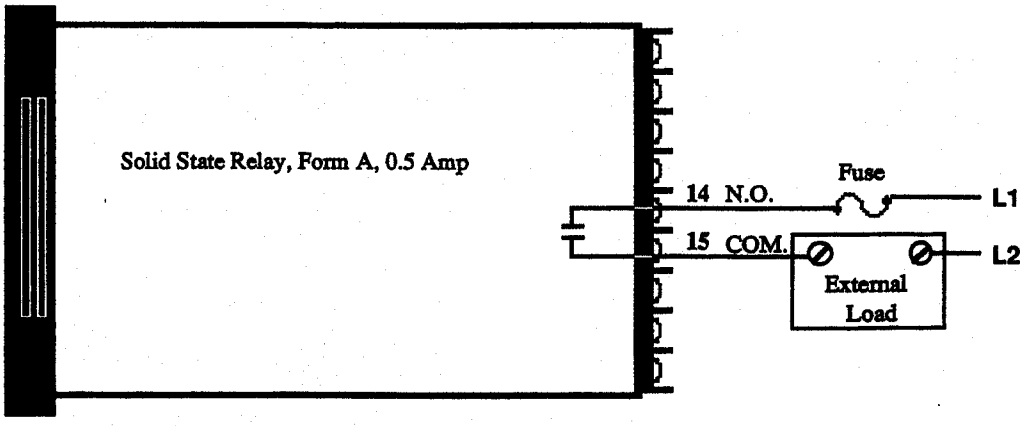


Figure 14 - S.S. Relay, Output 2, Option "B" Wiring Diagram.

Solid State Relay
Watlow's solid state relays change state at zero volts, which is "zero-cross switching." They are also optically isolated, which means the output circuitry is energized by infrared light striking a photo-sensitive device. This virtually eliminates electrically generated noise, plus output to input electrical isolation. **Off state impedance is 20KΩ minimum.**

Output 2 Option "C", **DC Output (Open Collector)**
Terminals 14 & 15
Model # CSM4 - _ _ **C** _ - _ 000

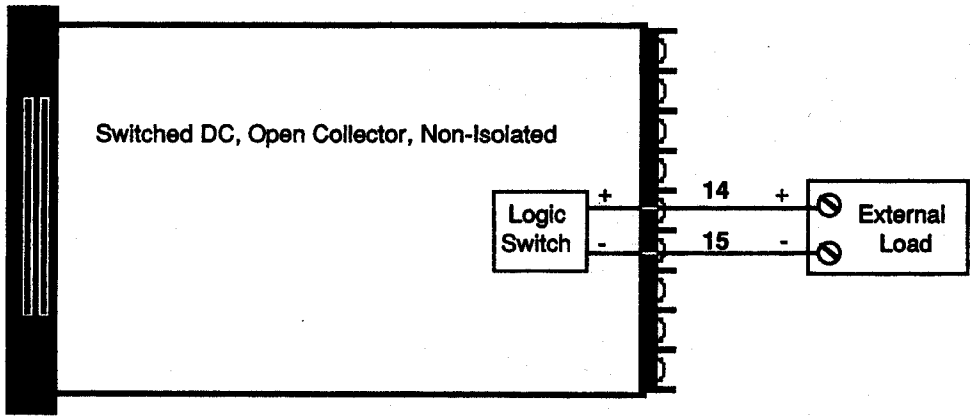


Figure 15 - DC Output (Open Collector), Output 2, Option "C" Wiring Diagram.

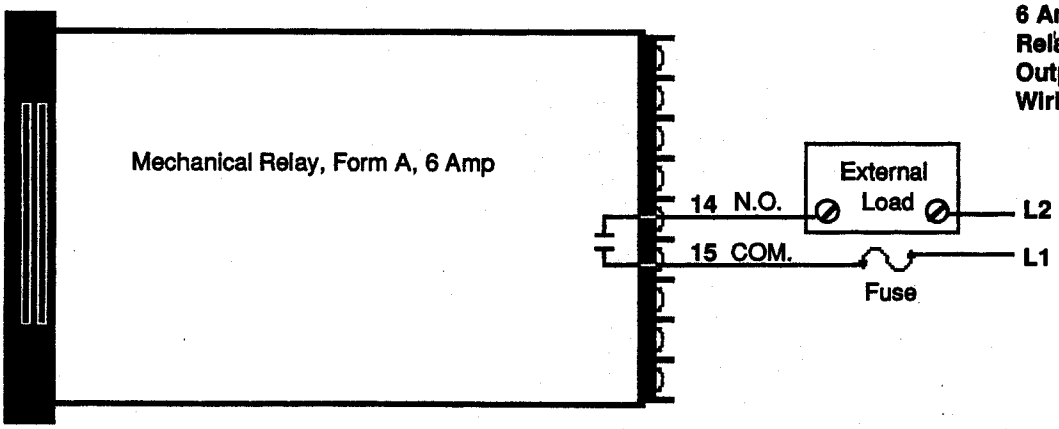
Switched DC
Watlow's solid state switch is a low current DC output (open collector) used to switch an external power switching device such as a SSR or an electro-mechanical relay. The input specifications of the power switching device must match those listed for the SS switch output. The power switching device must provide isolation between the SS switch output and load power since the SS switch output is a non-isolated output. Minimum load resistance is 500Ω. Available current is 9mA minimum and 22mA maximum.

CSM4-XX[C]X-X000

Terminal	Function	
14	DC +	Output #2
15	DC -	

Output 2 Option "D", **Mechanical Relay, Form A, 6 Amp**
Terminals 14 & 15
Model # CSM4 - _ _ **D** _ - _ 000

Figure 16 - 6 Amp Mechanical Relay, Output 2, Option "D" Wiring Diagram.



Mechanical Relay
The electro-mechanical relay is an electrical and mechanical device with moving parts. When power is applied to the relay solenoid, contact closure is created through movement of the "common" contact of the relay.
Off state impedance is 20KΩ minimum.

CSM4-XX[D]X-X000

Terminal	Function	
14	N.O.	Output #2
15	COM.	

Alarm Wiring

NOTE:

For more information on alarms and alarm jumper selection, see Pages 29 and 30.

Alarms Option "1", **Form A or B, 6 Amp**
Terminals 26 & 27
Model # CSM4-___1-_000

CSM4-XXX[1]-X000

Terminal	Function	
24	Not Used	
25	Not Used	
26	COM.	} Alarm #1
27	N.O. or N.C.	

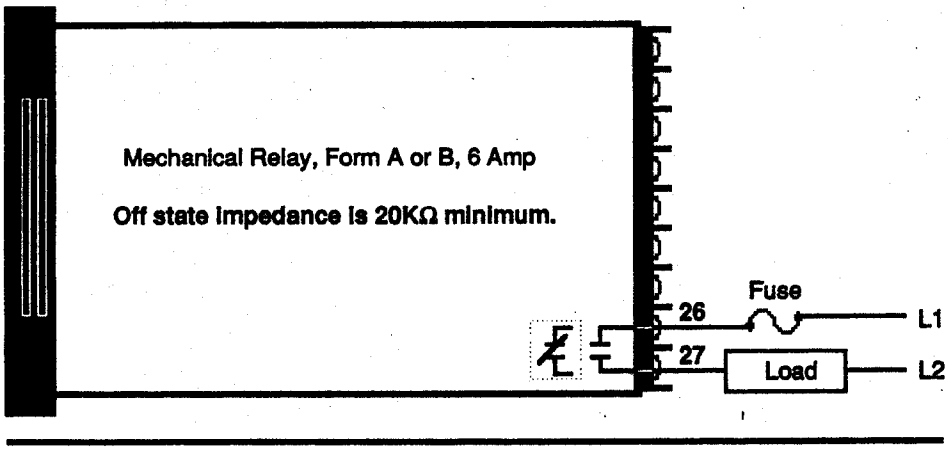


Figure 17 - Alarms Option 1 Wiring Diagram.

Alarms Option "2", **Form A or B, Dual 6 Amp**
Terminals 24 - 27
Model # CSM4-___2-_000

CSM4-XXX[2]-X000

Terminal	Function	
24	COM.	} Alarm #2
25	N.O. or N.C.	
26	COM.	} Alarm #1
27	N.O. or N.C.	

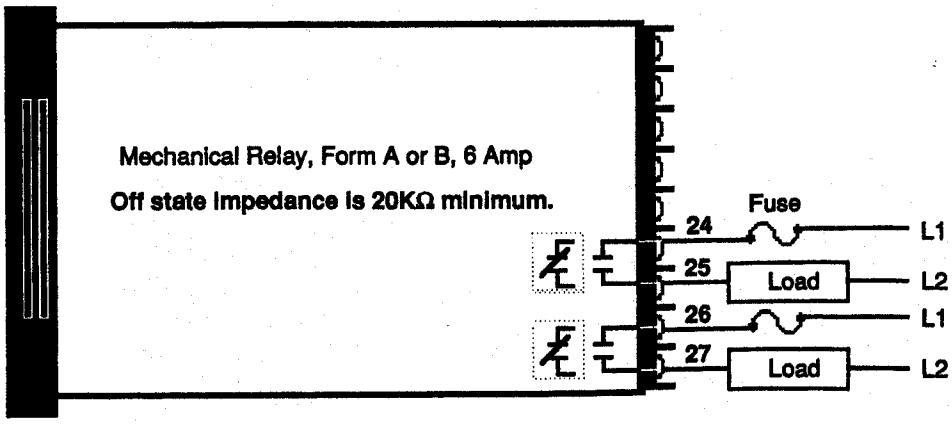


Figure 18 - Alarms Option 2 Wiring Diagram.

WARNING:

All wiring and fusing must conform to the National Electric Code NFPA70 and to any locally applicable codes. Failure to observe NEC safety guidelines could result in injury to personnel.

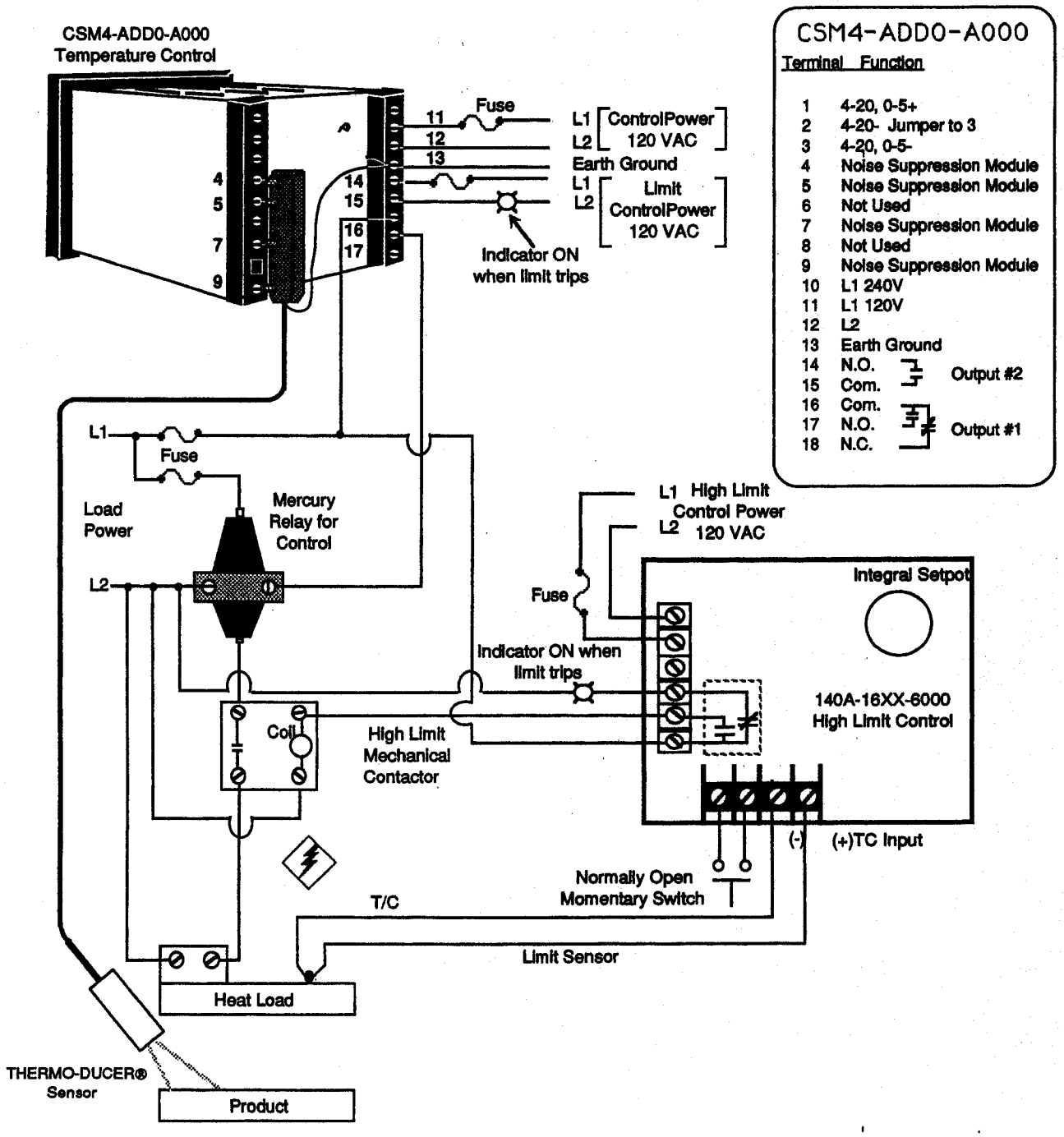
CAUTION:

Watlow mercury relay loads must have a unity power factor. For RESISTIVE LOADS ONLY.

Remove the short green ground jumper on the back of the CSM4 (T#13) if your control is mounted in a metal panel connected to safety (chassis) ground. Removing the jumper will prevent ground loops. OR

Leave the short green ground jumper in place if the CSM4 case is not connected to safety (chassis) ground.

Figure 19 - System Wiring Example

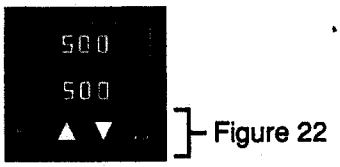


Chapter 3

How to Use the Keys and Displays

Use the following figures to learn the nature and function of the THERMO-DUCER® CSM4's keys and displays.

Figure 20 - THERMO-DUCER® CSM4 Front Panel Information

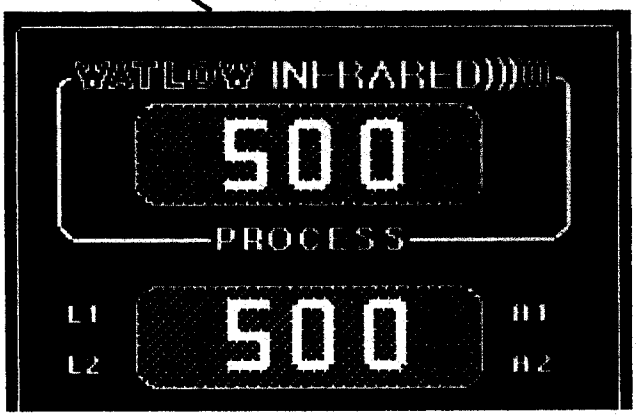


THERMO-DUCER® CSM4 Displays and Load LED's

NOTE:
The Upper display automatically displays the process value after 1 minute without key strokes.

Upper Display
Red, 0.56" high, seven segment, four digit LED display, indicating either process actual temperature, the operating parameter values, or an open sensor. When powering up, the Process display will be blank for 8 seconds.

Figure 21 - THERMO-DUCER® CSM4 Displays



L 1 & L2
When lit, these LED's tell you when Output 1 or Output 2 is energized. L2 only appears if your unit has the #2 Output type.

Lower Display
Red 0.56" high, seven segment, four digit LED display, indicating the set point, output value, prompts for data in the upper display, or error and alarm codes.

A1 & A2
When lit, these LEDs tell you when Alarm 1 or 2 is active. Only appears on those units with alarms option.

THERMO-DUCER® CSM4 Keys

UP/DOWN keys
When pressed simultaneously for 3 seconds, the Setup Menu appears displaying the LOC parameter. At the LOC parameter, continue to press the UP/DOWN keys, and the Calibration Menu will appear.

UP Key
Increases the value of the displayed parameter. A light touch increases the value by one. Holding the key down increases the display value at a rapid rate. New data is self entering in 5 seconds.

DOWN Key
Decreases the value of the displayed parameter. A light touch decreases the value by one. Holding the key down decreases the displayed value at a rapid rate. New data is self entering in 5 seconds.

AUTO/MAN Key
Pressed once, it clears any latched alarms. If the key is pressed again within 5 seconds, the control toggles between the Auto and Manual mode. While in the Manual mode, per-cent power is always displayed in the lower display.

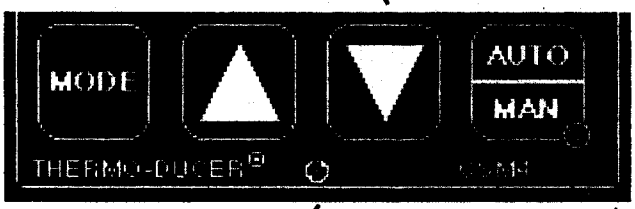


Figure 22 - THERMO-DUCER® CSM4 Keys

MODE Key
Steps the control through the Operating menu; also, in the Auto mode, enters new data selected less than 5 seconds previously .

Front Panel Locking Screw
Secures or releases the control chassis in its case.

Auto/Manual LED
Lit when the control is in Manual operation. Press the key twice to enter Auto operation. A blinking Auto/Manual LED indicates that pressing the Auto/Manual key toggles between Auto and Manual. After 5 seconds without pressing the Auto/Manual key, the LED stops blinking, and returns to its previous state.

Where To Go From Here

Now that you know how to read the keys and displays, continue to Chapter 4 to begin entering data and setting up your THERMO-DUCER® CSM4.

Chapter 4
Setup The THERMO-DUCER® CSM4

First, configure the CSM4's features to your application in the Setup Menu. **Make sure you enter the SC1 - SC4 values listed on the sticker, located on the sensor into the respective parameters in the Setup menu.** This configures the sensor to the control. See Page 19. Continue to the Operating Menu. Both tasks use the MODE key to move through the menus and the UP/ DOWN keys to select data. **For information on entering the Setup menu, refer to the next page.**

NOTE:
While in the Setup menu, all outputs are OFF.

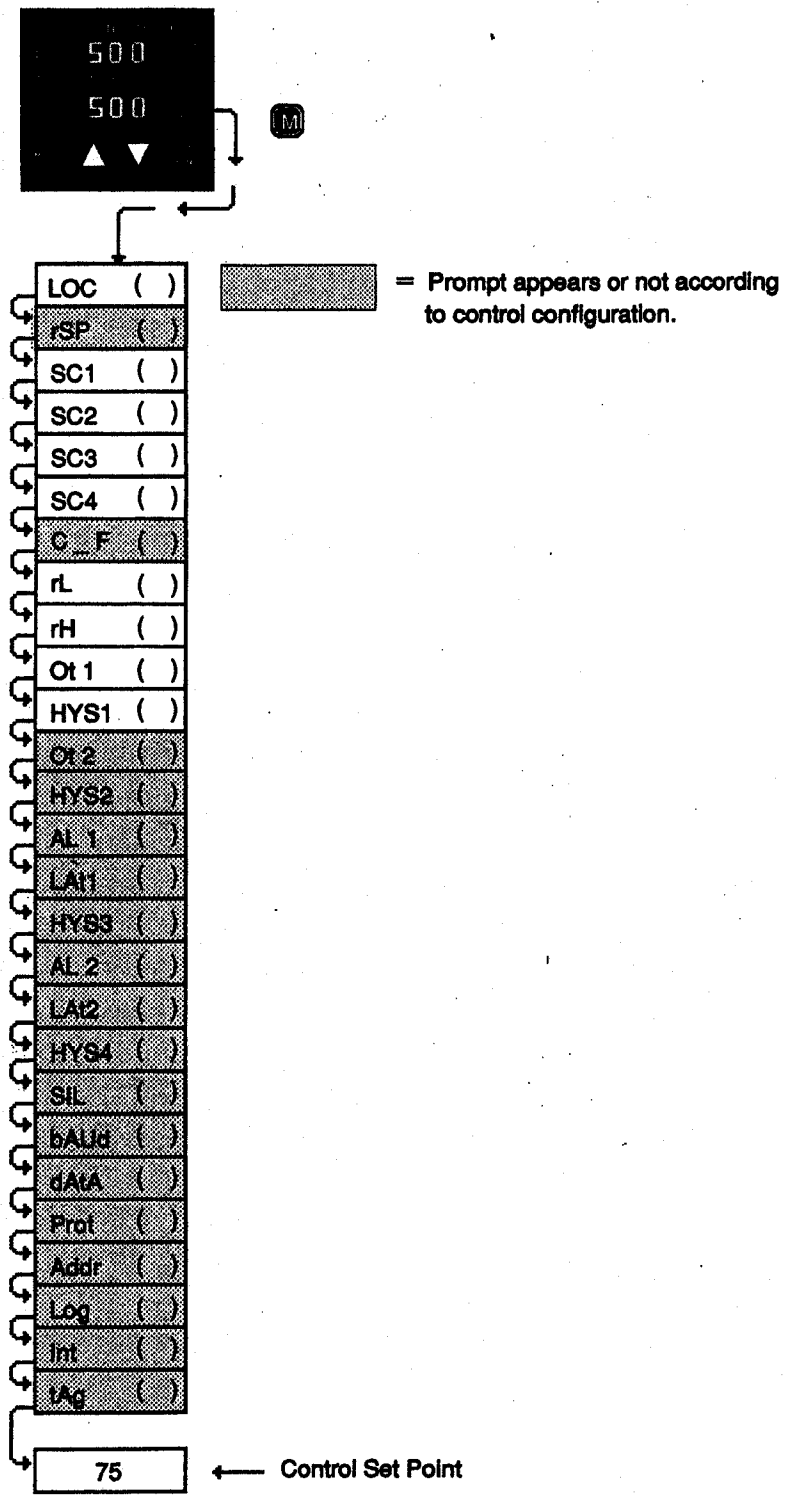


Figure 23 - The Setup Menu.

Entering the Setup Menu

The Setup Menu displays the parameters that configure the THERMO-DUCER® CSM4's features to your application.

To enter the Setup Menu, press the UP and DOWN keys simultaneously for 3 seconds. See Figure 24. The Lower display shows the LOC parameter, and the Upper display shows its current level. All keys are inactive until you release both keys. You can get to the LOC parameter from anywhere.

Use the MODE key to cycle through the menu; use the UP/DOWN keys to select Setup data. You may not see all parameters in this menu, depending on the unit's configuration and model number. After stepping through the menu, you will return to the control set point parameter under the Operation menu.

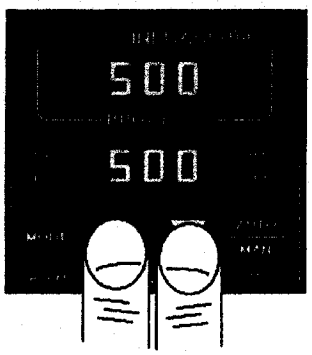


Figure 24 - Entering the Setup Menu.

Setup Parameters

When you are at the top of the menu, the THERMO-DUCER® CSM4's displays the user level of operation in the Upper display, and the LOC parameter in the Lower display.

When you press the MODE key, the value of the next parameter appears in the Upper display, and the parameter appears in the Lower display. For units with process input, see Page 26, the L-r parameter, on how LOC is affected.

Lock: Selects the level of operator lock-out.
Range: 0 - 3 **Default:** 0

LOC

The levels of operator lock-out are defined as follows:
LOC 0: All operating parameters may be viewed or changed. Manual operation **is** permitted.

LOC 1: The set point, actual, and L-r (if enabled) are the only visible parameters, set point **is** adjustable in this level. Manual operation **is** permitted.

LOC 2: The set point, actual, and L-r (if enabled) are the only visible parameters, set point **is** adjustable in this level. Manual operation is **not** permitted.

LOC 3: The set point and actual are the only visible parameters, set point is **not** adjustable in this level of lock-out. Manual operation is **not** permitted.

Remote Set Point: Enables the THERMO-DUCER® CSM4 to accept a remote set point signal from another device.
Range: OFF, 0-5, 420 **Default:** OFF

rSP

Sensor Calibration Parameters: Automatically calibrates the THERMO-DUCER® non-contact temperature sensor to the CSM4 control. Each sensor has a unique output characteristic curve that must be "fitted" to the control before operation. The SC1, SC2, SC3 and SC4 values appear on a sticker located on the THERMO-DUCER® sensor. These values must be entered exactly as they appear on the sensor prior to operation.

SC1
SC2
SC3
SC4

Ranges: SC1: -25.0 to 25.0 **Default:** 0.0
SC2: 0.40 to 2.00 1.00
SC3: 0.55 to 0.65 0.60
SC4: 1.04 to 1.44 1.24

C _ F

Celsius _ Fahrenheit: Selects the units of temperature measurement for the control.
Range: C or F **Default:** F

rL

Range Low: Selects the low limit of the operating range.
Range: Sensor range low to r **Default:** Low limit of sensor type

rH

Range High: Selects the high limit of the operating range.
Range: Sensor range high to rL **Default:** High limit of sensor type

Ot1

Output 1: Selects the output action for the primary output. Action in response to the difference between set point and process variable.
Range: ht, CL **Default:** ht

HYS1

Hysteresis 1: Selects the switching hysteresis for Output 1 when you select 0 (ON/OFF) under the Pb1 parameter. See Page 23 for the Pb1 parameter.
Range: 1°F - 99°F/1°C - 55°C **Default:** 3°F

Ot2

Output 2: Selects the output action for the secondary output. Action in response to the difference between set point and process variable. This parameter only appears if you have a secondary output.
Range: CL, ht, no **Default:** CL

HYS2

Hysteresis 2: Selects the switching hysteresis for Output 2 when 0 = (ON/OFF) under the Pb 2 parameter. See Page 24 for the Pb2 parameter. This parameter only appears if you have a secondary output; it will not appear if Ot2 = no.
Range: 1°F - 99°F/1°C - 55°C **Default:** 3°F

AL1

Alarm 1: Determines whether the alarm type for Alarm 1 is process, deviation, or none. A process alarm is set at an absolute temperature to prevent over/underrange. This parameter will only appear if you ordered alarms with your unit. Check the model number.
Range: Pr, dE, no **Default:** Pr

LAt1

Latching 1: Selects whether Alarm 1 is latching or non-latching. Latching alarms must be cleared before the alarm output will reset. Non-latching automatically resets the alarm output when the condition clears. This parameter will not appear if AL 1 = no, or your unit does not have alarms. Check the model number.
Range: LAt or nLA **Default:** nLA

HYS3

Hysteresis 3: Selects the switching hysteresis for Alarm 1 and appears if AL 1 = Pr or dE, and your unit has alarms. Check the model number.
Range: 1°F - 99°F/1°C - 55°C **Default:** 3°F

AL2

Alarm 2: Determines whether the alarm type for Alarm 2 is process, deviation, or none. A process alarm is set at an absolute temperature to prevent over/underrange. This parameter will only appear if you ordered alarms with your unit. Check the model number.
Range: Pr, dE, no **Default:** Pr

LAt2

Latching 2: Selects whether Alarm 2 is latching or non-latching. Latching alarms must be cleared before the alarm output will reset. Non-latching automatically resets the alarm output when the condition clears. This parameter will not appear if AL 1 = no, or your unit does not have alarms. Check the model number.
Range: LAt or nLA **Default:** nLA

HYS4

Hysteresis 4: Selects the switching hysteresis for Alarm 2 and appears if AL 2 = Pr or dE, and your unit has alarms. Check the model number.
Range: 1°F - 99°F/1°C - 55°C **Default:** 3°F

SIL

Silencing: Selects alarm silencing (inhibit) for Alarm 1. This parameter appears only when AL1 = dE. For more information see Page 31, "Using Alarms."
Range: On or OFF **Default:** OFF

bAUd

Baud: Represents the current baud rate for serial communications. This parameter will appear if your THERMO-DUCER® CSM4 has communications.
Range: 300, 600, 1200, 2400, 4800, 9600 **Default:** 1200

dAtA

Data: Allows the user to select the data bits and parity for communication. This parameter will appear if your THERMO-DUCER® CSM4 has communications.
Range: 7 o = 7 data bits and odd parity **Default:** 7 o
7 E = 7 data bits and even parity
8 n = 8 Data bits and no parity

Prot

Protocol: Selects the communication protocol. This parameter will appear if your THERMO-DUCER® CSM4 has communications.
FULL = ANSI X3.28 2.2 - A.3 On = XON - XOFF
Range: FULL or On **Default:** FULL

Addr

Address: Selects the address for this unit if Prot = FULL. This parameter will appear if your THERMO-DUCER® CSM4 has communications.
Range: 0 to 31 **Default:** 0

Log

Log: Selects the data logging function for a printout of the data. This parameter will appear if your THERMO-DUCER® CSM4 has communications, and Prot = On.
Range: On or OFF **Default:** OFF

Int

Interval: Selects the time interval for the logging function This parameter will appear if your THERMO-DUCER® CSM4 has communications, Prot = On, and Log = On.
Range: 0.0 to 60.0 minutes **Default:** 0.0

tag

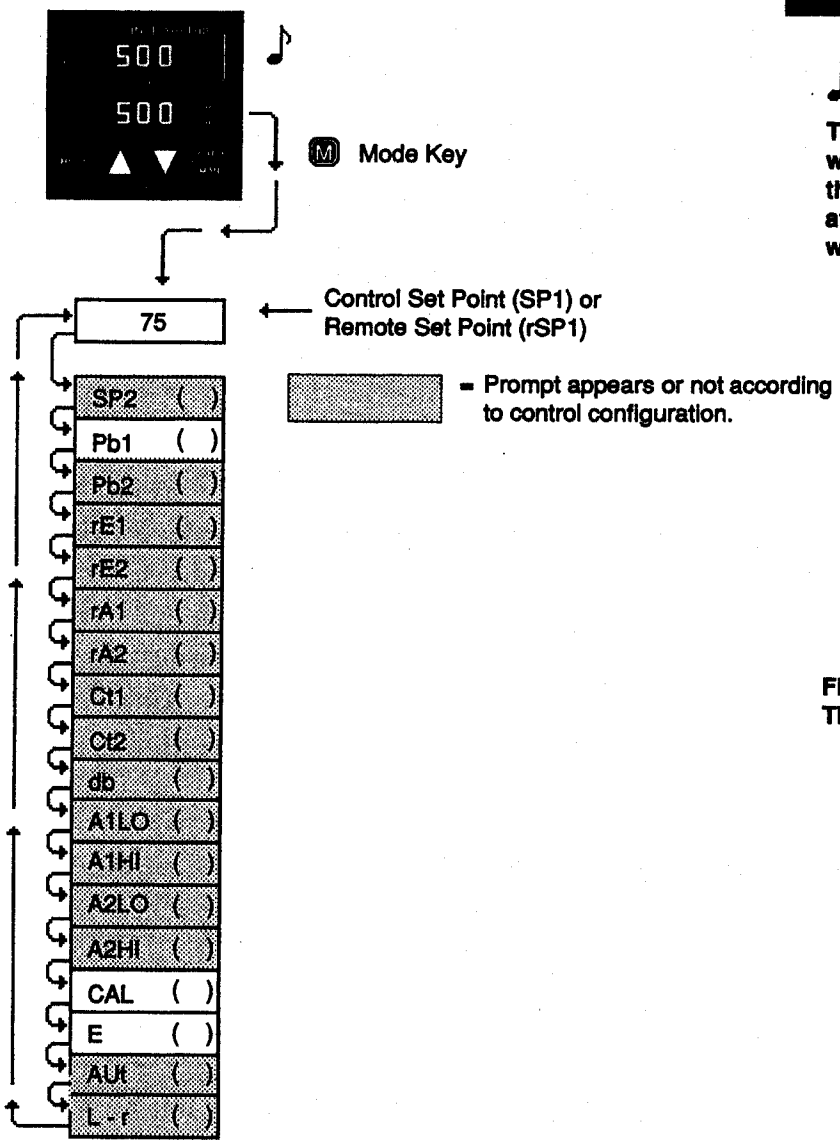
Tag: Selects what variables are to be transmitted out during the data logging function. This parameter will appear if your THERMO-DUCER® CSM4 has communications, Prot = On, and Log = On.
P = Process S = Set Point A = Alarm Set Points
Range: PSA, PS-, P-A, P--, -SA, -S-, --A, --- **Default:** ---

Table 2 - Setup Menu Prompts and Descriptions.

Setup Menu

Use this page as a master copy for configuring your THERMO-DUCER® CSM4.
Do not enter any values here; make photocopies instead.

Setup Parameters	Value	Range	Factory Default
LOC		0 - 3	0
rSP		OFF, 0-5, 420	OFF
SC1		-25.0 to 25.0	0.0
SC2		0.40 to 2.00	1.0
SC3		0.55 to 0.65	0.60
SC4		1.04 to 1.44	1.24
C _ F		C or F	F
rL		rL to rH	Input selection dependent.
rH		rH to rL	Input selection dependent.
Ot1		ht or CL	ht
HYS1		1°F - 99°F, 1°C - 55°C	3°F
Ot2		ht, CL or no	CL
HYS2		1°F - 99°F, 1°C - 55°C	3°F
AL1		Pr, dE or no	Pr
LAt 1		LAt or nLA Dependent on AL 1 = Pr or dE.	nLA
HYS3		1°F - 99°F, 1°C - 55°C	3°F
AL 2		Pr, dE or no	Pr
LAt 2		LAt or nLA	nLA
HYS4		1°F - 99°F, 1°C - 55°C	3°F
SIL		On or OFF	OFF
bAUd		300, 600, 1200, 2400, 4800, 9600	1200
dAtA		7 o = Odd parity, 7 E = Even parity 8 n = 8 data bits and no parity	7 o
Prot		FULL or On	FULL
Addr		0 to 31	0
Log		On or OFF	OFF
Int		0.0 to 60.0 minutes	0.0
tag		PSA, PS-, P-A, P--, -SA, -S-, --A, --- P = Process, S = Set point A = Alarm Set points	---



NOTE:
The Upper display will always return to the process value after 1 minute without key strokes.

Figure 25 - The Operation Menu.

Operation Parameters

Set Point 1: Sets the operating set point for Output 1. Represents the process value the system will try to achieve for Output 1. This prompt appears if L-r = L. The "SP1" parameter does not appear, the control set point **value** will.

[SP1]

Remote Set Point 1: Represents the remote set point when the L-r prompt is set to r. The "rSP1" parameter does not appear, a remote set point **value** will.

[rSP1]

Set Point 2: Sets the operating set point for Output 2 when control mode is ht/ht or CL/CL. SP2 only appears when Ot1 and Ot2 are the same, and functions as an ON/OFF control. **Range:** rL to rH **Default:** Same as primary set point.

SP2

Proportional Band 1: A proportional band expressed in degrees or process units, within which a controller proportioning function is active for Output 1. When Pb1 = 0, the unit functions as an ON/OFF control. The switching differential is then determined by the HYS1 parameter.
Range: 0 to 999°F/0 to 555°C **Default:** 25°F

Pb1

Pb2

Proportional Band 2: A proportional band expressed in degrees or process units, within which a controller proportioning function is active for Output 2. When Pb2 = 0, the unit functions as an ON/OFF control. The switching differential is then determined by the HYS2 parameter. This parameter will not appear if Ot 2 = no, Ot 2 is the same value as Ot 1, or your unit does not have Output 2.
Range: 0 to 999°F/0 to 555°C **Default:** 25°F

rE1

Reset 1: A reset (integral) control action for Output 1 that automatically eliminates offset, or "droop," between set point and actual process temperature in a proportional control. This parameter will not appear if Pb1 = 0.
Range: 0.00 to 9.99 repeats/minute **Default:** 0.00

rE2

Reset 2: A reset (integral) control action for Output 2 that automatically eliminates offset, or "droop," between set point and actual process temperature in a proportional control. This parameter will not appear if Pb 2 = 0, or if Ot 2 = no, Ot2 is the same value as Ot 1, or your unit does not have Output 2.
Range: 0.00 to 9.99 repeats/minute **Default:** 0.00

rA1

Rate 1: The rate (derivative) function for Output 1 of the TERMO-DUCER® CSM4. The rate is determined by how fast the error is changing. This parameter will not appear if Pb 1 = 0.
Range: 0.00 to 9.99 minutes **Default:** 0.00

rA2

Rate 2: The rate (derivative) function for Output 2. The rate is determined by how fast the error is changing. This parameter will not appear if Pb 2 = 0, Ot 2 = no, Ot 2 is the same value as Ot 1, or your unit does not have Output 2.
Range: 0.00 to 9.99 minutes **Default:** 0.00

Ct1

Cycle Time 1: Expressed in seconds for a controller to complete one ON/OFF cycle for Output 1. Time between successive turn ons. This parameter will not appear if Pb 1 = 0, or Output 1 is 4-20mA.
Range: 1 to 60 seconds **Default:** 5

Ct2

Cycle Time 2: Expressed in seconds for a controller to complete one ON. OFF cycle for Output 2. Time between successive turn ons. This parameter will not appear if Pb 2 = 0, Ot 2 = no, Ot 2 is the same value as Ot 1, or your unit does not have Output 2.
Range: 1 to 60 seconds **Default:** 5

db

Dead band: The area between Output 1 and 2 where no heating or cooling takes place in a heat/cool proportional control. This parameter will only appear if your unit is set up as a ht/CL or CL/ht unit.
Range: ±0 to 99°F/0 to 55°C **Default:** 0

Alarm 1 Low: This parameter represents the low process alarm or low deviation alarm for Alarm 1. This parameter will not appear if AL 1 = no or your unit does not have alarms. See the model number. If AL 1 = dE:
Range: 0 to -999°F/0 to -999°C **Default:** -999°F
If AL 1 = Pr: **Range:** rL to A1HI **Default:** rL

A1LO

Alarm 1 High: This parameter represents the high process alarm or high deviation alarm for Alarm 1. This parameter will not appear if AL 1 = no or your unit does not have alarms. See the model number. If AL 1 = dE:
Range: 0 to 999°F/0 to 999°C **Default:** 999°F
If AL 1 = Pr; **Range:** A1LO to rH **Default:** rH

A1HI

Alarm 2 Low: Represents the low process alarm or low deviation alarm for Alarm 2. This parameter will not appear if AL 2 = no, or your unit does not have Alarm 2. See the model number. If AL 2 = dE:
Range: 0 to -999°F/0 to -999°C **Default:** -999°C
If AL 2 = Pr: **Range:** rL to A2HI **Default:** rL

A2LO

Alarm 2 High: Represents the high process alarm or high deviation alarm for Alarm 2. This parameter will not appear if AL 2 = no, or your unit does not have Alarm 2. See the model number. If AL 2 = dE:
Range: 0 to 999°F/0 to 999°C **Default:** 999°F
If AL 2 = Pr: **Range:** A2LO to rH **Default:** rH

A2HI

Calibration Offset: Adds or subtracts degrees from the input signal.
Range: -99°F to 99°F/-55°C to 55°C **Default:** 0

CAL

Emissivity: A ratio of radiation emitted by a surface to the radiation emitted by a blackbody under the same temperature, spectral, and directional conditions.
Range: 0.33 to 1.00 **Default:** 0.90

E

Auto-Tune: This parameter initiates auto-tune for Output 1. This parameter appears if Ot 1 =ht.
Range: 0 = off, 1 = slow, 2 = medium, 3 = fast **Default:** 0

AUt

Local-Remote: Selects a local or remote set point for the THERMO-DUCER® CSM4. This parameter only appears if the LOC parameter = 0, 1 or 2, and rSP = 0-5 or 420. If L-r = r, the remote set point will be displayed in place of the internal set point.
Range: L = Local operation r = remote operation **Default:** L

L-r

Operation Menu

Table 2 - Operation Menu Prompts and Descriptions.

Use this page as a master copy for your THERMO-DUCER® CSM4 Operation Parameters. **Do not enter any values here; make photocopies instead.**

Operation Parameters	Value	Range	Factory Default
SP1		rL to rH Appears if L-r = L.	75°F
rSP1		rL to rH Appears if L-r = r.	- -
SP2		rL to rH	Same as primary set point.
Pb1		0 - 999°F/0 - 555°C 0=ON/OFF control. HYS1 =swtch. diff.	25°F
Pb2		Same as Pb1. Will not appear if Ot 2 = no, or Ot 2 = Ot 1.	0°F
rE1		0.00 to 9.99 repeats/min. 0.00 = No Reset. Won't appear if Pb1 = 0.	0.00 repeats/min.
rE2		Same as rE1. Will not appear if Pb2 = 0, Ot 2 = no, or Ot2 = Ot1.	0.00 repeats/min.
rA1		0.00 to 9.99 min. 0.00 = No Rate. Will not appear if Pb1 = 0	0.00 min.
rA2		Same as rA1. Will not appear if Pb2 = 0, Ot2 = no, or Ot2 = Ot1.	0.00 min.
Ct1		1 to 60 seconds Won't appear if Pb1 = 0, or output 1 is 4-20	5 seconds
Ct2		1 to 60 seconds Will not appear if Pb2 = 0, Ot2 = no, or Ot2 = Ot1.	5 seconds
db		±0 - 99°F/±0 - 55°C Appears if Ht/CL or CL/Ht.	0
A1LO - Deviation dE Process Pr		-999° to 0° rL to A1HI Will not appear if AL1 = no, or no alarms.	-999° rL
A1HI - Deviation dE Process Pr		0° to 999° A1LO to rH Will not appear if AL1 = no, or no alarms.	999° rH
A2LO- Deviation dE Process Pr		-999° to 0° rL to A2HI Will not appear if AL2 = no, or no Alarm 2.	-999 rL
A2HI- Deviation dE Process Pr		0° to 999° A2LO to rH Will not appear if AL2 = no, or no Alarm 2.	999° rH
CAL		±99°F/±55°C	0
E		0.33 to 1.00	.90
AUt		0-3 Appears if Ot1 = Ht and L-r = L.	0
L-r		L or r. Appears if rsP = 0-5 or 420.	L

Chapter 5

How to Tune and Operate

Tuning - Automatic

Auto-tuning: The THERMO-DUCER® CSM4 can automatically tune the PID parameters to fit the characteristics of your particular thermal system.

The auto-tuning procedure operates on a thermal response value — slow, medium, or fast. Use the slow thermal response when your process does not need to reach set point too rapidly, or if it usually does not exceed set point a lot. A fast thermal response produces a rapid temperature change over a short period of time.

Once the auto-tune sequence has begun, the heat proportional band will be set to 0 and the control goes into an ON/OFF mode of control at 90% of the established set point. The displayed set point remains unchanged.

The cool output remains off for the duration of the tuning. Once the control finishes "learning" the system, it returns to a standard PID control with the heat PID values automatically set as a result of the auto-tuning. Tuning is complete within 80 minutes. Any change of the set point, while in auto-tune, re-initiates the auto-tune procedure.

The THERMO-DUCER® CSM4 will **not** Auto-tune while in remote set point. Transferring from local to remote set point takes the CSM4 out of Auto-tune and may bump to the new set point determined by the input voltage. Remote to local is bumpless.

To start auto-tuning:

1. **Press the MODE key** until the **AUt** prompt appears in the data display.

2. **Select a thermal response value**, 1=slow, 2=medium, and 3=fast, using the UP/DOWN keys. A thermal response value of 2 satisfactorily tunes most thermal systems.

3. **Press the MODE key.** While the control is in the tuning mode, the lower display alternately displays the normal information and the prompt **At**. The time between alternations is 1 second.

4. **When tuning is complete,** the displays return to their previous state and **AUt** reverts to 0. The CSM4 installed appropriate PID tuning parameters and saved them in the non-volatile memory.

To abort auto-tuning, the operator must reset the **AUt** parameter to 0, or press the AUTO/MAN key twice. The auto-tuning process may also be aborted by pressing the AUTO/MANUAL key twice, or by cycling the power off and on. In all cases, aborting auto-tune restores all original values.

Tuning - Manual

For optimum control performance, tune the THERMO-DUCER® CSM4 to the thermal system. The tuning settings here are for a broad spectrum of applications; your system may have somewhat different requirements. **NOTE: This is a slow procedure, taking from minutes to hours to obtain optimum value.**

1. **Apply power to the** THERMO-DUCER® CSM4 and enter a set point. Begin with these Operation Parameters: **Pb1** = 1, **rE1** = 0.00, **rA1** = 0.00, **Ct1** = 5, **CAL** = 0, **AUt**= 0.

2. **Proportional Band Adjustment (Output 1)**: Gradually increase **Pb1** until the Upper display temperature stabilizes to a constant value. The process temperature will not be right on set point because the initial reset value is 0.00 repeats per minute. (When **Pb1** = 0; **rE1** and **rA1** are inoperative, and the CSM4 functions as a simple ON/OFF control.) The HYSX parameter determines the switching differential value.

NOTE:
An X applies to either Hysteresis 1, 2, 3, or 4.

3. **Reset Adjustment**: Gradually increase **rE1** until the upper display temperature begins to oscillate or "hunt." Then slowly decrease **rE1** until the Upper display stabilizes again near set point.

4. **Cycle Time Adjustment**: Set **Ct1** as required. Faster cycle times sometimes achieve the best system control. However, if a mechanical contactor or solenoid is switching power to the load, a longer cycle time may be desirable to minimize wear on the mechanical components. Experiment until the cycle time is consistent with the quality of control you want.

5. **Rate Adjustment**: Increase **rA1** to 1.00 min. Then raise set point by 20° to 30°F, or 11° to 17°C. Observe the system's approach to set point. If the load temperature overshoots set point, increase **rA1** to 2.00 minutes.

   Then raise set point by 20 to 30°F, or 11 to 17°C and watch the approach to the new set point. If you increase **rA1** too much, approach to set point will be very sluggish. Repeat as necessary until the system rises to the new set point without overshooting or approaching set point too slowly.

6. **Calibration Offset Adjustment:** You may want your system to control to a temperature other than the value coming from the input sensor. If so, measure the difference between that temperature (perhaps at another point in the system) and the process value showing in the Upper display. Then enter the **CAL** offset value you want. Calibration offset adds or subtracts degrees from the value of the input signal.

Manual and Automatic Operation

To change from manual to auto operation, press the AUTO/MAN key twice.

Manual operation provides direct (time proportioned % power) control of the outputs from -100% to 100%. The CSM4 allows a negative output value only with a CI (Cool) selection on either Ot1 or Ot2. Automatic operation provides closed loop ON/OFF or PID control. When the operation transfers from a closed loop to an open loop, the CSM4 retains the power level from the closed loop control. When the CSM4 returns to the closed loop control, it restores the previous set point temperature.

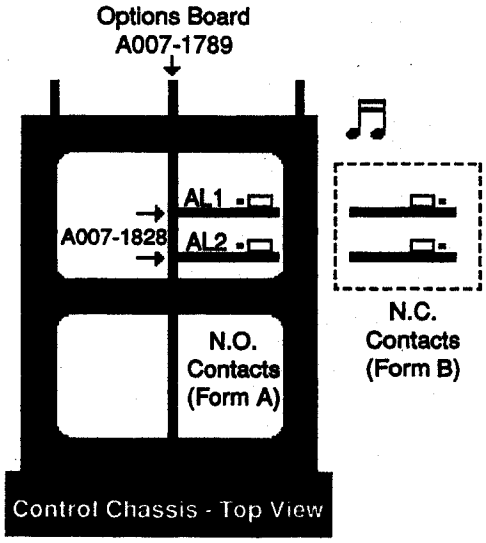
Indication of Auto/Manual operation is the LED located on the AUTO/MAN key. When the LED is ON, the control is in the Manual operation. When the LED is OFF, the control is in AUTO operation. When the LED flashes, press the key again within five seconds to complete the change in operation. If the sensor is open and LOC = 0 or 1, the THERMO-DUCER® CSM4 switches to Manual operation (time proportioned % power), if the output was stable before the break occurred.

When transferring from auto to manual operation, the control output(s) will not change("bumpless," smooth transition). When transferring from manual to automatic operation, the control output(s) may change significantly. In manual, the output value (% power) appears in the lower display. In automatic operation, the set point appears.

Changing the Position of an Alarm Jumper

Whenever you change the position of a jumper, follow this procedure:

1. Remove power from the THERMO-DUCER® CSM4. Turn the front panel screw 90° counterclockwise.
2. Grip the front panel bezel and pull it straight out from the control case. The control chassis will come out of the case as you pull the bezel.
3. Set the jumper to the position you want. See Figure 26 for jumper location.
4. Return the control chassis to the case. Be sure you have it oriented correctly. It will not fit in upside down, but check just the same. Press firmly, but gently, to seat the chassis.



NOTE:
Depending on the unit you order, your control may have 0, 1, or 2 alarm jumpers.

NOTE:
The alarm output de-energizes upon an alarm or power interruption to the CSM4's power supply. When you select N.O. Contacts, the contact is open when an alarm occurs. When selecting N.C. Contacts, the contact closes when an alarm occurs.

Figure 26 - Alarms Jumper Location.

Using Alarms

The THERMO-DUCER® CSM4 has two alarm types, Process or Deviation. A **Process alarm** sets an absolute temperature when the process exceeds that absolute temperature limit. The Process alarm set points may be independently set high and low.

A **Deviation alarm** alerts the operator when the process strays too far from set point. The operator can enter independent high and low alarm setting. The reference for the deviation alarm is the set point. Any change in set point causes a corresponding shift in the deviation alarm. Example: If your set point is 100°F, and you have a deviation alarm set at +7°F as the high limit, and -5°F as the low limit, the high alarm will trip at 107°F, and the low alarm at 95°F. If you change the set point to 130°F, the alarms will follow the set point and trip at 137°F and 125°F.

Alarm Silencing for alarm output A1 is available with the deviation alarm. This overrides alarm A1 during power up. The **non-latching** mode automatically enables alarm output A1 on initial power up. In the **latching** mode, the operator must manually disable the alarm by pressing the AUTO/MAN key once. In both cases alarm silencing disables the A1 alarm output relay, but the A1 LED displays the alarm condition until the process value is within the "safe" region of the deviation alarm band. Once the process value crosses into the "safe" region, both a latching or a non-latching alarm is ready. Any future deviation outside this safe band triggers an alarm.

Both Process and Deviation alarms can be latching or non-latching. The operator must **manually reset** a **latching alarm** before the alarm will reset. The operator must also remove the condition that created the alarm. When the operator removes the condition causing the alarm, a **non-latching alarm automatically** resets the alarm output.

NOTE:
An X applies to either Hysteresis 1, 2, 3, or 4.

Flashing 'LO" or "HI" in the lower display indicates an alarm. The Lower display alternately shows information from the current parameter and the "LO" or "HI" alarm message at one second intervals. The alarm output is de-energized and the A1 or A2 LED is lit.

To clear an alarm...

- **First correct the alarm condition, then...**

  - **If the alarm is latching...**
    Clear it manually; press the AUTO/MAN key once as soon as the process temperature is inside the alarm limit according to the HYSX parameter.

  - **If the alarm is non-latching...**
    The alarm will clear itself automatically as soon as the process temperature is inside the alarm limit according to the HYSX parameter.

CAUTION:
An alarm display will be masked by an error condition or when the control is in the Calibration or Setup Menus.

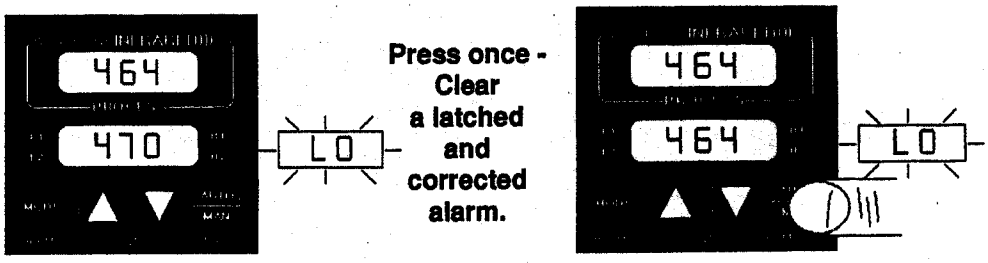


Figure 27 - Alarm Display Examples

How To Deal With Error Codes

Four dashes, "- - - -", in the upper display indicate a THERMO-DUCER® CSM4 error.

- **If operator access is LOC 0 or 1...**
  - Press the AUTO/MAN key twice to see the error code for one second.
- **If operator access is LOC 2 or 3...**
  - The error code is already in the lower display.
- **Error code definitions and actions...**

Er 1 - Sensor overrange error
The sensor input generated a value that was higher than that allowed for the range of the sensor, or the A/D circuitry malfunctioned. Enter a valid input. The A/D value is above the range limits, but within the A/D conversion limits.

Er 2 - Sensor underrange error
The sensor input generated a value that was lower than that allowed for the range of the sensor, the cable or sensor is shorted, or the A/D circuitry malfunctioned. Enter a valid input. The A/D value is below the range limits, but within the A/D conversion limits.

Er 3 - Ambient error
The ambient temperature of the sensor has exceeded its ambient temperature range. Check the specification for the ambient temperature range.

Er 4 - Configuration error
The unit's microprocessor is faulty; call the factory.

Er 5 - Non volatile checksum error
The nonvolatile memory checksum discovered a checksum error. Sensor calibration values must be re-entered. Unless a momentary power interruption occurred while the unit was storing data, the nonvolatile memory is bad. Call the factory.

Er 6 - A/D underflow error
The A/D circuit is underrange. An open sensor or cable is the most likely cause. Check the sensor and cable; if the connection is good, and the sensor functions properly, call the factory. The A/D underrange voltage is too low to convert an A/D signal.

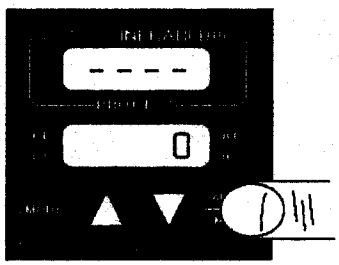
Er 7 - A/D overflow error
The A/D circuit is overrange. An open sensor or cable is the most likely cause. Check the sensor and cable; if the connection is good, and the sensor functions properly, call the factory. The A/D overrange voltage is too high to convert an A/D signal.

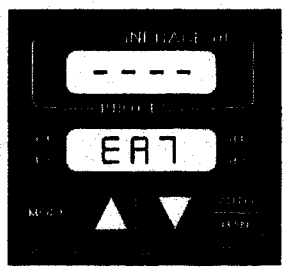
- **To clear a corrected error...**
  - Cycle power to the control.

NOTE:
Electrical noise or a noise event, vibration or excess environmental moisture or temperature may cause THERMO-DUCER® CSM4 errors to occur. If the cause of an error is not otherwise apparent, check for these.

Figure 28 - Error Code Display Examples

Press twice - Read error





Er 1, 2, 3, 6 & 7 Errors - Control Outputs May Be ON

- **If operator access is LOC 0 or 1...**

  ...and the control was in AUTO operation when the error occurred, it will go into MANUAL (% power) operation. If the output power is less than 75% power, and a <5% change in power within the last two minutes, the CSM4 switches into Manual operation at the last Automatic power level. If the control was in MANUAL operation, it will remain there. (You must press the AUTO/MAN key twice to see the error code.) The alarm output (if present) will be in its alarm state (LED lit). The Upper display will read "- - - -". The Lower display indicates the error code.

  If the control was operating with stable output values when the error occurred, it continues to operate at those levels on a % power basis. If output values were not stable, the control outputs go to 0% power (OFF).

- **If operator access is LOC 2 or 3...**

  The control remains in AUTO operation. The control outputs will go OFF. The AUTO/MAN and MODE keys are inactive. The UP/DOWN keys may be used together to enter the Setup Menu. The alarm output (if present) will be in its alarm state (LED lit). The Upper display will read "- - - -". The Lower display indicates the error code.

- **To clear a corrected error...**

  - Cycle power to the control.

Er 4 & 5 Errors - Control Outputs Will Be OFF

- **Error codes Er 4 and Er 5 will result in these conditons:**

  - The control is in AUTO operation with both Outputs OFF.
  - The alarm outputs, if present, are in their alarm state (de-energized with the LED lit).
  - The Upper display indicates the process value.
  - The Lower display indicates the error code.
  - All Keys are inactive.
  - All Setup Menu parameters return to default values.
  - The above conditions occur regardless of the value of LOC, or the presence of the Setup or Calibration Menus.

- **To clear a corrected error...**

  - Cycle power to the control.

Appendix 1

Control Mode

- Single or dual set point, non-ramping.
- Single input, dual outputs.
- Dual alarms.
- RS-422A, RS-423A, or EIA-485 data communications available.
- Control outputs: User selectable as: Heat, Heat/Heat, Heat/Cool, Cool, Cool/Cool, Cool/Heat.
  - Outputs independent, or related via deadband for Heat/Cool.
  - ON/OFF: Determined by the HYSX parameter for Outputs 1 and 2.
  - PID parameters:
    Proportional band: 0 to 999°F/0 to 555°C
    Reset: 0.00 to 9.99 repeats per minute.
    Rate: 0.00 to 9.99 minutes.
    Cycle time: 1 to 60 seconds.
  - Deadband: ±99°F or ±55°C.
  - Emissivity: 0.33 to 1.00

NOTE:
An X applies to either Hysteresis 1, 2, 3, or 4.

Operator Interface

- Membrane front panel.
- Dual, four digit 0.56" LED displays.
- MODE, AUTO/MANUAL, UP, and DOWN keys.

Input

- THERMO-DUCER® non-contact temperature sensor.
- Sensor break protection de-energizes control outputs to protect system.
- °F or °C are user selectable.
- Process input for remote set point capability.

Primary Output (Heating or Cooling)

- Solid state relay, 0.5A @ 24VAC min., 264VAC maximum, opto-isolated, zero cross switching. Off state impedance is 20KΩ minimum.
- Electromechanical relay, Form C, 6A @ 120/240VAC, 6A @ 28VDC, 1/8 hp. @ 120VAC, 125VA @ 120VAC. Off state impedance is 20KΩ min.
- Switched DC (Open collector), 500Ω minimum load resistance, 1KΩ load, 9mA minimum, 22mA maximum, non-isolated.
- 4-20mA reverse or direct acting into a 600Ω maximum load impedance, non-isolated.

Secondary Output (Heat, Cool or None)

- Solid state relay, 0.5A @ 24VAC min., 264VAC maximum, opto-isolated, zero cross switching. Off state impedance is 20KΩ minimum.
- Electromechanical relay, Form A, 6A @ 120/240VAC, 6A @ 28VDC, 1/8 hp. @ 120VAC, 125VA @ 120VAC. Off state impedance is 20KΩ min.
- Switched DC (Open collector), 500Ω minimum load resistance, 1KΩ load, 9mA minimum, 22mA maximum, non-isolated.

Alarms

- Electromechanical relay, Form A (N.O.) or B (N.C.), 6A @ 28VDC, 1/8 hp. @ 120VAC, 125VA @ 120VAC. Off state impedance is 20KΩ minimum.
- Latching or non-latching.
- Process or deviation.
- Separate high and low values.
- Alarm silencing (inhibit) on power up for Alarm 1.

Accuracy

- Calibration Accuracy: ±0.5% of span, ± 1 LSD, 75°F(24°C) ambient and rated line voltage.
- Accuracy Span: 500°F or 270°C minimum.
- Temperature Stability: 0.3°F/°F (0.1°C/°C) change in ambient.

Communications

- Serial data communications.
- RS-422A or RS-423A (RS-232C compatible) or EIA-485.
- ANSI X3.28 protocol, or XON/XOFF protocol.
- Isolated.
- Data logging.
- #6 compression type screw terminals.

Agency Approvals

- UL and CSA pending.

Terminals

- #6 compression type screw terminals.

Power

- 120/240VAC +10%, -15%, 50/60Hz, ± 5%.
- 16VA maximum.
- Data retention upon power failure via nonvolatile memory.

Operating Environment

- 32 to 130°F/0 to 50°C.
- 0 to 90% RH, non-condensing.

Dimensions

• Height:	3.8 in	97 mm
• Width:	3.8 in	97 mm
• Overall depth:	8.0 in	203 mm
• Behind panel depth:	7.0 in	178 mm
• Weight:	2.5 lb max.	0.4 kg

THERMO-DUCER® CSM4 Model Number Information

The THERMO-DUCER® CSM4 Model Number, listed on your unit sticker, is defined below.

C S M 4 - _ _ _ _ - _ 0 0 0

THERMO-DUCER®
CSM4 = 1/4 DIN, single input, dual output, dual alarms, dual digital displays.

THERMO-DUCER® Range
A = THERMO-DUCER® 511

#1 Output Type
B = Solid State Relay, Form A, 0.5A
C = Switched DC, (Open Collector), non-isolated
D = Mechanical Relay, Form C, 6A
F = Process 4-20mA, non-isolated

#2 Output Type
A = None
B = Solid State Relay, Form A, 0.5A
C = Switched DC, (Open Collector), non-isolated
D = Mechanical Relay, Form A, 6A

Alarms
0 = None
1 = Single, Mechanical Relay, 6A, Form A or B
2 = Dual, Mechanical Relay, 6A, Form A or B

Communications
A = None
B = Isolated RS-423/RS-422
D = Isolated EIA-485

The items listed below are ordered separately. Refer to the user's manual for each item, or contact Watlow Infrared.

- Noise Filter Module: See 500 Series User's Manual
- THERMO-DUCER® 500 Series: See 500 Series User's Manual
- Multiple Position Mounting Bracket: 0216-0860
- Mounting Collar: 0221-0039
- Air Purge Collar: 0221-0038

Appendix 2

Noise and Installation Guidelines

Installation Guidelines For Preventing Noise

For improved electrical noise immunity, install the THERMO-DUCER® CSM4 as far away as possible from motors, relays, and other similar electrical noise generators.

Do not run the Noise Suppressed Interconnect Cable (NSIC) in the same bundle as AC power lines. Grouping these lines in the same bundle can create electrical noise interference which may result in error codes in the THERMO-DUCER® CSM4.

The Culprit

Most noise problems stem from wiring practices. They're the major means of coupling noise from its sources to the control circuit. The following information will tell you how to eliminate or decrease noise.

An Information Resource

For wiring guidelines , refer to the IEEE Standard No. 518-1982, available from IEEE, Inc. 345 East 47th Street, New York, NY 10017.

Noise Sources

- Switches and relay contacts operating inductive loads such as motors, coils, solenoids, and relays, etc.
- Thyristors or other semiconductor devices which are not zero crossover-fired (randomly-fired or phase angle-fired devices).
- All welding machinery.
- Heavy current carrying conductors.
- Fluorescent and neon lights.

How To Decrease Noise Sensitivity

- Physical separation and wire routing must be given careful consideration in planning the layout of the system. For example, A.C. power supply lines should be bundled together and physically kept separate from the NSIC input signal lines. A 12" (305 mm) minimum separation is usually effective. Keep all switched output signal lines (high power level) separate from input signal lines (sensor lines). Cross other wiring at 90° angles whenever crossing lines is unavoidable.

- Another important practice is to look at the system layout; identify and locate electrical noise sources such as solenoids, relay contacts, motors, etc. Route the wire bundles and cables as far away as possible from these noise sources. Don't mount relays or switching devices close to a microprocessor control. Don't have phase angle-fired devices in the same electrical enclosure or on the same power line with the control.

- Shielded cables should be used for all low power signal lines to protect from magnetic and electrostatic coupling of noise. Some simple pointers are:

  ◊ Whenever possible, run low level signal lines unbroken from signal source to the control circuit.
  ◊ Connect the shield to the control circuit common at the control end only. Never leave the shield unconnected at both ends. Never connect both shield ends to a common or ground.
  ◊ Maintain shield continuity at daisy chain connection points by reconnecting the broken shield.
  ◊ Assume no electrostatic shielding when using the shield as a signal return. If you must do this, use triaxed cable (electrostatically shielded coaxial cable).

- Use twisted pair wire any time control circuit signals must travel over two feet, or when you bundle them parallel with other wires.

- The size or gauge of wire should be selected by calculating the maximum circuit current and choosing the gauge meeting that requirement. Using greatly larger wire sizes than required generally increases the likelihood of electrostatic (capacitance) coupling of noise.

- You must eliminate ground loops in the entire control system. You will spot obvious loops by studying the "as-built" wiring diagram. There are also not-so-obvious ground loops that result from connecting internal circuit commons in the manufacturer's equipment. An example is a control circuit designed to work with a grounded sensor input.

- Do not daisy chain A.C. power (or return) lines, or output signal (or return) lines to multiple control circuits. Use a direct line from the power source to each input requiring A.C. power. Avoid paralleling L1 (power lead) and L2 (return lead) to load power solenoids, contactors, and control circuits. If an application uses L1 (power lead) to switch a load, L2 (return lead) has the same switched signal and could couple unwanted noise into a control circuit.

- Grounding the chassis of each piece of equipment in the system is very important. Here is a simple practice that works best. 1) Connect each individual equipment to the over-all chassis immediately adjacent to that piece. 2) Tie all the major chassis ground terminals together with one lead (usually green wire) tied to ground at one point. Don't connect ground to the control case if the control is in a grounded enclosure (preventing ground loops).

- Do not confuse chassis grounds (safety ground) with control circuit commons or with A.C. supply L2 (return or neutral line). Each return system wiring must be separate. Absolutely never use chassis ground (safety) as a conductor to return circuit current.

How To Eliminate Noise

- Use "snubbers" ("QUENCHARC™") to filter out noise generated by devices such as relays, relay contacts, solenoids, motors, etc. A snubber is a simple filter device using a 0.1µf, 600 volt, non-polarized capacitor in series with a 100 ohm, 1/2 watt resistor. The device can be used on A.C. or D.C. circuits to effectively dampen noise at its source.

- The general purpose Watlow snubber, described above, is 0804-0147-0000. For other "QUENCHARC" sizes contact:
  PAKTRON
  P.O. Box 5439
  Lynchburg, VA 24502
  Phone: 804/239-6941

- A Metal Oxide Varistor (MOV) can be used to limit voltage "spikes" that occur on the A.C. supply lines as a result of lightning strikes, switching large motors, etc. The MOV is available in several varieties and for 115 or 230 volt lines. The device dissipates the voltage "spikes" to ground and in doing so repeatedly, deteriorates its ability to function. MOVs have a limited life.

- Watlow stocks several MOVs. See Table 4.

- "Islatrols" and other similar power line filters are designed to carry the power for the control circuit and "buffer" the control circuit from A.C. line noise. Devices like the Islatrol use media (electromagnetic filtering) other than electric circuits to filter out electrical noise. Take care in matching the power capabilities of the filter with power demands of the circuit. Keep line filters as close to the control as possible to minimize the area for interference pick up.

- Islatrols are available from: Control Concepts Corporation
  328 Water Street
  P.O. Box 1380
  Binghamton, NY 13902-1380
  Phone: 607/724-2484

  I - 101 (1A,120VAC)
  I - 105 (5A, 120VAC)
  I - 115 (15A, 120VAC)
  I - 202 (2.5A, 208/240VAC)
  I - 207 (7.5A, 208/240VAC)

- The ultimate protection is an "uninterruptable" power supply. This "senses" the A.C. power line; when the line fluctuates, a battery powered 60Hz inverted circuit takes over, supplying power within one-half to one cycle of the A.C. line; very expensive.

How To Check For Ground Loops

To check for ground loops, disconnect the ground wire at the ground termination. Now measure the resistance from the wire to the termination point. The ohmmeter should read a high ohm value. If you have a low ohm value across this gap, there is at least one ground loop present in your system.

Or check for continuity; your reading should be "open." If you do find continuity, you must now begin looking for the ground loops. Begin disconnecting grounds in the system one at a time, checking for continuity after each disconnection. When continuity reads "open" you have eliminated the ground loop(s). Also, as you reconnect grounds, keep making the continuity test. It is possible to reconnect a ground loop.

Noise Suppression Devices Available From Watlow

Watlow Controls stocks a few key noise suppression parts. You may order these by calling your local Watlow distributor.

Item	Electrical Ratings	Part Number
Common Mode Line Filter	250V, 3 Amp	0804-0196-0000
Differential Mode Line Filter	Refer to the Isiatrol listing above.	
Metal Oxide Varistor	150V, 80 Joule	0802-0273-0000
MOV	130V, 38 Joule	0802-0304-0000
MOV	275V, 75 Joule	0802-0266-0000
MOV	275V, 140 Joule	0802-0405-0000

Table 4 - Noise Suppression Device Ratings

Line Filtering Configurations For Controls

These three diagrams show you filter configurations for removing input power noise. Choose the one best suited for your system. For very dirty or critical applications - use a microcomputer-regulated power supply or Uninterruptable Power Supply (U.P.S.) Don't fasten common mode line filters or filters with metal cases to metal that is at ground potential. This prevents ground loops and maintains filter effectiveness.

♪ 1

NOTE: Keep filters 12 inches or less from the control. Minimize the line distance where noise can be re-introduced to control.

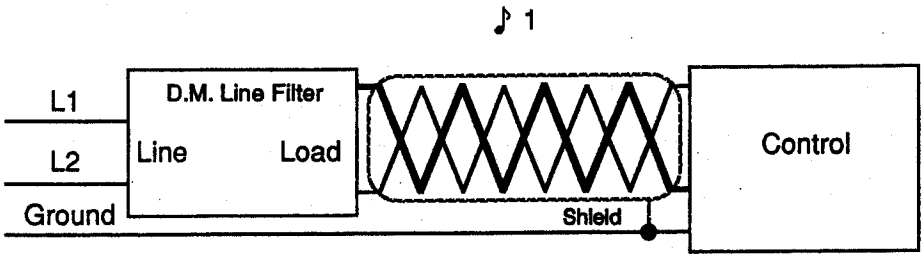


Figure 29 - Differential Mode Filter Wiring

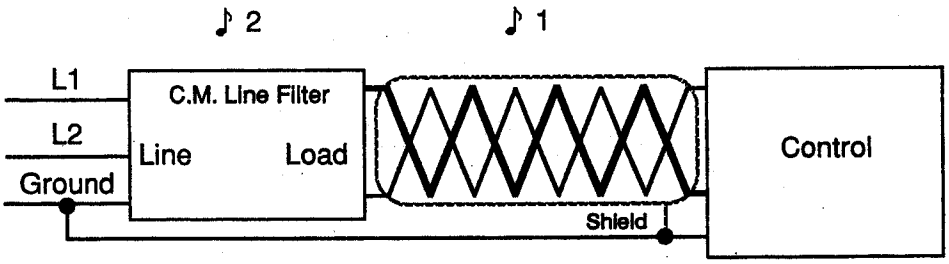


Figure 30 - Common Mode Filter Wiring

♪ 2

NOTE: To prevent ground loops do not fasten common mode line filters or filters with metal cases to metal that is at ground potential. Doing so will reduce filter effectiveness.

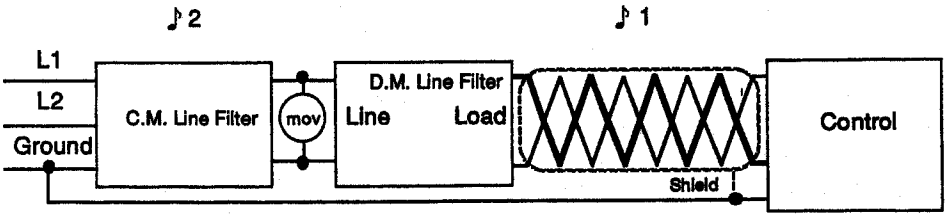


Figure 31 - Combination Differential/ Common Mode Filter Wiring

Appendix 3

Before attempting to calibrate, make sure you have the proper equipment called for in each procedure.

Calibration Menu

In the Calibration Menu, various input signals must be supplied in order for the control to go through its auto calibration. The calibration menu can only be entered from the LOC parameter in the Setup menu. Press the UP/DOWN keys simultaneously for 3 seconds (± 1 second). The CAL parameter appears in the lower display with "no" in the upper display.

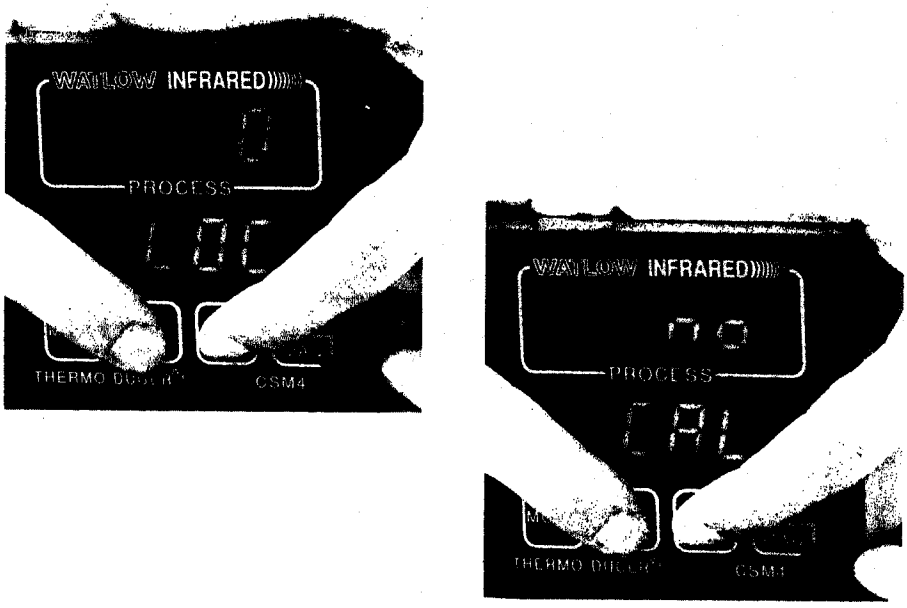


Figure 32 - Entering the Calibration Menu.

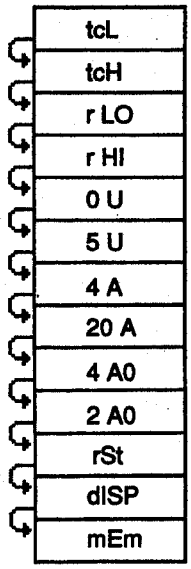
NOTE:
Calibration values will not be retained unless you are in the MANUAL mode. Do not enter the MANUAL mode until you are at the correct input parameters.

Any inadvertent change in the displayed data, when pressing the UP/DOWN keys, is ignored. Calibration values are not retained unless you are in the MANUAL mode. Press the UP/DOWN key to change the upper display to "YES." Press the MODE key to enter the calibration sequence.

NOTE:
While in the Calibration Menu, all outputs are OFF, except the 4-20mA output.

Upon entering the calibration menu, the top display window indicates CAL. The upper display continues to indicate CAL (with the exception of calibration of the 4-20mA output) while the operator walks through the entire calibration parameter list. While calibrating the 4-20mA output, the upper display contains a numeric value to be slewed up or down until the output value is correct. The control uses the lower display to prompt the user to what the input should be.

Once the input has been properly established and maintained for 5 to 10 seconds, the MODE key may then be used to display the next prompt. After the final input is established, press the MODE key twice to return the unit to the configuration menu at the top of the parameter list.



Sensor, low end uncompensated. 0mV
Sensor, high end compensated. 1mV
Ambient low voltage (V) end.
Ambient high voltage (V) end.
Process input. 0V
Process input. 5V
Process input. 4mA
Process input. 20mA
Process output. 4mA
Process output. 20mA
Restore factory calibration values.
Factory use only.
Factory use only.

Figure 33 - The Calibration Menu.

THERMO-DUCER® CSM4 Field Calibration Procedure

Equipment Required

- Precision millivolt source #1, 0 - 50mV minimum range, 0.1µV resolution.
- Precision millivolt source #2, 0 - 1 volt minimum range, 0.1mV resolution.

Setup and Calibration

1. Connect the AC line voltage L1, L2, and ground to the proper terminals on the CSM4. See Chapter 2.
2. Connect millivolt source #1 to Terminal #9 Negative and Terminal #7 Positive on the CSM4 terminal strip. Use regular 20 - 24 gauge wire.
3. Connect millivolt source #2 to Terminal #6 Negative and Terminal #4 Positive on the CSM4 terminal strip.
4. Apply power to the unit and allow it to warm up for 15 minutes. After warm-up put the unit in the CAL menu. See Figure 32 on Page 41.

IMPORTANT:
When the MANUAL LED is ON the unit is automatically calibrating. Your sequence is VERY important. Always move to the next prompt before changing the calibration equipment.

5. Press the AUTO/MAN key twice to enter the MANUAL mode. The unit is calibrating when the MANUAL LED is ON. Make sure the unit is in the MANUAL mode only when you are in the correct parameters. See Figure 33.
6. At the "tcL" prompt, enter 0mV from millivolt source #1 to the CSM4. Allow at least 10 seconds to stabilize after entering each value. Press the MODE key.
7. At the "tcH" prompt, enter 1mV from millivolt source #1 to the CSM4.
8. At the "rLO" prompt, enter 0.544 Volts from millivolt source #2 to the CSM4.
9. At the "rHI" prompt, enter 0.600 Volts from millivolt source #2 to the CSM4. Press the AUTO/MAN key twice to turn the manual LED off.
10. To conclude the calibration procedure, advance the MODE key to the next prompt or exit the CAL menu. The unit will leave the CAL mode if 1 minute passes between key activations.

0 - 5 Volt Input Field Calibration Procedure

Before attempting any calibration procedure, make sure you have the proper equipment called for in each procedure.

Equipment Required

- Precision voltage source 0 - 5 volt minimum range with 0.001 volt resolution.

Setup and Calibration

NOTE:

Before calibration on an installed control, make sure all data and parameters are documented. See Setup and Operation Charts, Pages 22 and 26.

1. Connect the AC line voltage L1, L2, and ground to the proper terminals on the CSM4. See Chapter 2.

2. Connect the voltage/current source to Terminal #1 and #3 on the CSM4 terminal strip. Use regular 20-24 gauge wire.

3. Apply power to the unit and allow it to warm up for 15 minutes. **After warm-up** put the unit in the CAL menu. See Figure 32 on Page 41. Press the MODE key until the **O U** prompt is displayed.

IMPORTANT:
When the MANUAL LED is ON the unit is automatically calibrating. Your sequence is VERY important. Always move to the next prompt before changing the calibration equipment.

4. Press the AUTO/MAN key twice to enter the MANUAL mode. The unit is calibrating when the MANUAL LED is ON. Make sure the unit is in the MANUAL mode **only** when you are in the correct parameters. See Figure 33.

5. At the **O U** prompt, set the voltage/current source to 0.000 Volts. Allow at least 10 seconds to stabilize. Press the MODE key.

6. At the **5 U** prompt, set the voltage/current source to 5.000 Volts. Allow at least 10 seconds to stabilize. The unit will leave the CAL mode if 1 minute passes between key activations. Press the AUTO/MAN key twice to exit the MANUAL mode. To conclude the 0-5 Volt calibration, advance the MODE key to the next prompt or exit the CAL menu.

NOTE:

Not all parameters will appear. They are dependent on your unit type. Use only the steps that apply to your unit.

4-20mA Input Field Calibration Procedure

Before attempting any calibration procedure, make sure you have the proper equipment called for in each procedure.

Equipment Required

- Precision current source 0-20mA minimum range with 0.01mA resolution.

NOTE:
Not all parameters will appear. They are dependent on your unit type. Use only the steps that apply to your unit.

Setup and Calibration

NOTE:
Before calibration on an installed control, make sure all data and parameters are documented. See Setup and Operation Charts, Pages 22 and 26.

1. Connect the AC line voltage L1, L2, and ground to the proper terminals on the CSM4. See Chapter 2.

2. Connect the voltage/current source to Terminal #1 and #3. Jumper Terminal #2 to #3 on the CSM4 terminal strip. Use regular 20-24 gauge wire.

3. Apply power to the unit and allow it to warm up for 15 minutes. **After warm-up** put the unit in the CAL menu. See Figure 32 on Page 41. Press the MODE key until the **4A** prompt is displayed.

IMPORTANT:
When the MANUAL LED is ON the unit is automatically calibrating. Your sequence is VERY important. Always move to the next prompt before changing the calibration equipment.

4. Press the AUTO/MAN key twice to enter the MANUAL mode. The unit is calibrating when the MANUAL LED is ON. Make sure the unit is in the MANUAL mode **only** when you are in the correct parameters. See Figure 33.

5. At the **4 A** prompt, set the mA source to 4.00mA. Allow at least 10 seconds to stabilize. Press the MODE key.

6. At the **20A** prompt, set the voltage/current source to 20.00mA. Allow at least 10 seconds to stabilize. The unit will leave the CAL mode if 1 minute passes between key activations. Press the AUTO/MAN key twice to exit the MANUAL mode. To conclude the 4-20mA input calibration, advance the MODE key to the next prompt or exit the CAL menu.

4-20mA Output Field Calibration Procedure

Before attempting any calibration procedure, make sure you have the proper equipment called for in each procedure.

Equipment Required

- 470Ω, 1/2 watt 10% resistor.
- 4 - 1/2 digit Digital Multimeter.

Setup and Calibration

NOTE:

Before calibration on an installed control, make sure all data and parameters are documented. See Setup and Operation Charts, Pages 22 and 26.

1. Connect the AC line voltage L1, L2, and ground to the proper terminals of the CSM4. See Chapter 2.

2. Connect the multimeter in series with the 470Ω resistor to Terminal #17 Positive and 18 Negative on the THERMO-DUCER® CSM4 terminal strip. Use regular 20 - 24 gauge wire.

3. Apply power to the unit and allow it to warm up for 15 minutes. **After warm-up** put the unit in the CAL menu. See Figure 32 on Page 41. Press the MODE key until **4A0** prompt is displayed.

IMPORTANT:
When the MANUAL LED is ON the unit is automatically calibrating. Your sequence is VERY important. Always move to the next prompt before changing the calibration equipment.

4. Press the AUTO/MAN key twice to enter the MANUAL mode. The unit is calibrating when the MANUAL LED is ON. Make sure the unit is in the MANUAL mode **only** when you are in the correct parameters.

5. At the **4A0** prompt, the multimeter should read approximately 4mA. Allow at least 10 seconds to stabilize.

6. Use the UP/DOWN keys (reverse acting) to adjust the reading on the multimeter for 20.15mA ±0.10mA. Press the MODE key.

7. At the **2A0** prompt, the multimeter should read approximately 20mA. Allow at lest 10 seconds to stabilize. The unit will leave the CAL mode if 1 minute passes between key activations.

8. Use the UP/DOWN keys (reverse acting) to adjust the reading on the multimeter for 20.15mA ±0.10mA.

9. Press the AUTO/MAN key twice to exit the MANUAL mode. To conclude the 4-20mA output calibration, advance the MODE key to the next prompt or exit the CAL menu.

NOTE:

Not all parameters will appear. They are dependent on your unit type. Use only the steps that apply to your unit.

Glossary, A-H

This glossary includes general thermal system control terms.

Alarm: A condition, generated by a controller, indicating that the process has exceeded or fallen below the set or limit point.

Alarm Silence: Disables the alarm relay output.

Anti-reset: Control feature that inhibits automatic reset action outside the proportional band.

Automatic prompts: Data entry points where a microprocessor-based control "prompts" or asks the operator/programmer for information input.

Auto-tune: Automatically tunes the THERMO-DUCER® CSM4 PID parameters to fit the characteristics of your particular thermal system.

Black-body: An ideal surface that absorbs all radiation regardless of wavelength and direction. The surface also radiates the maximum energy possible for given spectral and temperature conditions. A blackbody has an emissivity of 1.00.

Bumpless transfer: When transferring from auto to manual operation, the control output(s) will not change ("bumpless," smooth transition).

Closed loop: Control system that has a sensing device for process variable feedback.

Cycle time: The time necessary to complete a full ON-through-OFF period in a time proportioning control system.

Data Logging: A convenient replacement for chart recorders. Information is sent from the CSM4 to a serial printer. Provides a handy reference to review process performance.

Dead band: A temperature band between heating and cooling functions.

Derivative: Anticipatory action that senses the rate of change of the process, and compensates to minimize overshoot and undershoot. Also "rate."

Deviation alarm: An alarm referenced at a fixed number of degrees, plus or minus, from set point.

Default parameters: The parameters, or programmed instructions, permanently stored in microprocessor software to provide a data base.

Display capability: In a digital indicating instrument, the entire possible span of a particular parameter or value.

Droop: Difference in temperature between set point and stabilized process temperature.

Duty cycle: Percentage of "load ON time" relative to total cycle time.

Emissivity: A ratio of radiation emitted from a surface compared to a blackbody at the same temperature with similar spectral and directional conditions.

Hysteresis: In ON/OFF control, the temperature change necessary to change the output from full ON to full OFF.

Hunting: Oscillation or fluctuation of process temperature between set point and process variable.

Infrared sensing device: A non-contact temperature sensing device that intercepts energy emitted from an object, converts this energy to a signal output that is transmitted to a temperature controller.

Input: Process variable information being supplied to the instrument.

Integral: Control action that automatically eliminates offset, or "droop," between set point and actual process temperature. Also "reset."

Isolation: Electrical separation of sensor from high voltage circuitry. Allows for application of grounded or ungrounded sensing element.

Offset: Adjustment to actual input temperature and to the temperature values the THERMO-DUCER® CSM4 uses for display and control.

ON/OFF control: Control of temperature about a set point by turning the output full ON below set point and full OFF above set point in the heat mode.

Open loop: Control system with no sensory feedback.

Output: Action in response to difference between set point and process variable.

Overshoot: Condition where temperature exceeds setpoint due to initial power up or process changes.

P control: Proportioning control.

Parameter: A physical property whose value determines the response of an electronic control to given inputs.

PD control: Proportioning control with rate action.

PI control: Proportioning control with auto-reset.

PID control: Proportioning control with auto-reset and rate.

Process variable: Thermal system element to be regulated, such as time, temperature, relative humidity, etc.

Programmed display data: Displayed information which gives the operator/programmer the "programmed" or intended process information, i.e., intended set point, intended alarm limit, etc. See "Actual displayed data."

Proportional band: Span of temperature about the set point where time proportional control action takes place.

Proportioning control: See Time Proportioning Control.

Glossary, R - Z

Rate: Anticipatory action that senses the rate of change of temperature and compensates to minimize overshoot. Also "derivative."

Rate Band: A thermal control band that defines where the rate (derivative) function begins. A Watlow rate band occurs centered on set point at one or more times the width of the proportional band.

Reset: Control action that automatically eliminates offset, or "droop," between set point and actual process temperature. Also "integral."

Reset windup inhibit: Synonymous with anti-reset. See "Anti-reset."

Set point: Intended value of the process variable.

Switching sensitivity: In ON/OFF control, the temperature change necessary to change the output from full ON to full OFF.

Thermal system: A regulated environment consisting of a heat source, heat transfer medium, sensing device and a process variable control instrument.

Three mode control: Proportioning control with reset and rate.

Time Proportioning Control: Action which varies the amount of ON and OFF time when "close" to the set point, i.e., in the proportional band. This variance is proportional to the difference between the set point and the actual process temperature. In other words, the amount of time the output relay is energized depends on the system temperature.

Triac: Solid state switching device.

Upper display data: Displayed information which gives the operator/programmer real or "actual" data, i.e., actual process temperature. See "Programmed display data."

Warm Start: Start-up condition where all program information is remembered by the instrument's memory back-up protection.

Zero switching: Action that provides output switching only at the zero voltage crossing points of the AC line.

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Warranty

The Watlow THERMO-DUCER® CSM4 is warranted to be free of defects in material and workmanship for 36 months after delivery to the first purchaser for use, providing that the units have not been misapplied. Since Watlow has no control over their use, and sometimes misuse, we cannot guarantee against failure. Watlow's obligations hereunder, at Watlow's option, are limited to replacement, repair or refund of purchase price, and parts which upon examination prove to be defective within the warranty period specified. This warranty does not apply to damage resulting from transportation, alteration, misuse, or abuse.

Returns

1. Call Watlow Infrared, 319/382-8446, for a Return Material Authorization (RMA) number before returning any item for repair. We need this information:
   - Ship to address
   - Bill to address
   - Contact name
   - Phone number
   - Ship via
   - Your P.O. number
   - Symptoms and/or special instructions
   - Name and phone number of person returning the material.

2. Prior approval and an RMA number, from Watlow Infrared, is needed when returning any unused product for credit. Make sure the RMA number is on the outside of the carton, and on all paperwork returned. Ship on a Freight Prepaid basis.

3. After we receive your return, we will examine it and determine the cause for your action.

4. In cases of manufacturing defect, we will enter a repair order, replacement order, or issue credit for material. A 20 percent restocking charge is applied for all returned stock controls and accessories.

5. If the unit is unrepairable, it will be returned to you with a letter of explanation. Repair costs will not exceed 50 percent of the original cost.

Watlow Infrared

Watlow Infrared is a division of Watlow Electric Mfg. Co., St. Louis, MO, a manufacturer of industrial electric heating products, since 1922. Watlow begins with a full set of specifications and completes an industrial product that is manufactured totally in-house, in the U.S.A. Watlow products include electric heaters, sensors, controls and switching devices.

Notes

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